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TROPICAL DISEASES
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COLONY AND PROTECTORATE OF KENYA.

ANNUAL MEDICAL REPORT

FOR THE

YEAR ENDING 31st DECEMBER, 1921.

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MEDICAL DEPARTMENT,
HEAD OFFICES,
NAIROBI,
4th August, 1922.

SIR,

I have the honour to submit for the information of His Excellency the Governor and for transmission to the Right Honourable the Secretary of State the Medical Report on the health and sanitary condition of the Colony and Protectorate of Kenya for the year 1921, together with the returns, etc., appended thereto.

2. The delay in presentation is due in the first place to sickness on the part of one medical officer whose report was essential in compilation, to the necessary time taken in the transmission of reports from remote out-stations and to the large amount of material to be incorporated. The compilation of the Report also coincided with the work necessitated by the proposals for retrenchment.

3. You will note I have ventured to change somewhat the form under which the Report appears. My object being to present a more connected account and to avoid duplication, and I trust this will be approved.

4. I have included the report of the bacteriological laboratory, which previously was published separately, as it appeared that this important section was necessary in order that the whole activities of the Department might be reviewed.

5. The large size which the Report has assumed is due to the fact that it appeared desirable to give a full account of the new activities of the Department in connection with the Native Reserves, to give an indication of the directions in which further extensions are necessary and desirable when sufficient staff is available and to emphasize the fact that the work at present being performed does not do more than touch the fringe of what is required.

I have the honour to be,
SIR,
Your obedient Servant,
JOHN L. GILKS,
Principal Medical Officer.

To
The Honourable,
The Colonial Secretary,
Nairobi.

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ANNUAL REPORT OF THE BACTERIOLOGICAL LABORATORY FOR 1921.

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I.—ADMINISTRATION.

SECTION I.—DEPARTMENTAL.

1.—ESTABLISHMENT.

The establishment of the Medical Department as sanctioned for the year 1921 was as follows:—

Administrative Division.

Principal Medical Officer	1
Deputy Principal Medical Officer	1
Chief Sanitation Officer	1
Office Superintendent	1
Accountant	1
European Clerks	2
1st Grade Clerk	1
2nd Grade Clerks	2
3rd Grade Clerks	6
4th Grade Clerks	21
Medical Storekeeper	1
Issuers of Medical Stores	2
Messengers and Packers	18

Medical Division.

Senior Medical Officers	5
Resident Surgical Officer	1
Dental Surgeon	1
Medical Officers	19
District Surgeons	4
European Dispensers	4
Matron	1
Nursing Sisters	25
Superintendent, Lunatic Asylum	1
Warders, Lunatic Asylum	2
Matron, Lunatic Asylum	1
Assistant Matron, Lunatic Asylum	1
Assistant Surgeons	12
Sub-Assistant Surgeons	60
Compounders	18
Native Hospital Attendants	(as necessary)
Lunatic Asylum Attendants	(as necessary)

Sanitation Division.

Medical Officers of Health	8
Sanitary Inspectors, 1st Grade	6
Sanitary Inspectors, 2nd Grade	14
Sanitary Overseers	6
Nurses	2
European Clerk	1
Vaccinators	56
Mechanics for Clayton Disinfectors	4
Native Attendants for Infectious Diseases Hospitals, Leper, Lazarettos and Quarantine Stations	(as necessary)

LABORATORY DIVISION.

Bacteriologist	1
1st Assistant Bacteriologist	1
2nd Assistant Bacteriologist	1
Laboratory Assistant (European)	1
Laboratory Assistants (Asiatic)	3
Native Laboratory Attendants	(as necessary)

2.—APPOINTMENTS.

The following appointments were made during the year :—

MEDICAL OFFICERS.

Dr. J. L. Gilks, to be Principal Medical Officer, 7th February, 1921.
,, A. R. Paterson, to be Chief Sanitation Officer, 8th December, 1921.
,, N. P. Jewell, M.C., to be Senior Medical Officer, 7th February, 1921.
,, F. J. C. Johnstone, Medical Officer, 4th February, 1921.
,, G. V. Allen, 2nd Assistant Bacteriologist, 4th February, 1921.
,, K. T. K. Wallington, Medical Officer, 17th February, 1921.
,, F. H. B. Norrie, Medical Officer, 4th March, 1921.
,, E. A. Davison, Medical Officer, 18th March, 1921.
,, J. O. Beven, Medical Officer, 18th May, 1921.
,, R. A. W. Procter, M.C., Medical Officer, 19th June, 1921.
,, R. J. Harley-Mason, Medical Officer, 15th July, 1921.
,, J. C. J. Callanan, Medical Officer, 4th August, 1921.
,, C. H. Brennan, M.C., Medical Officer, 1st September, 1921.
,, R. N. Hunter, Medical Officer, 1st September, 1921.
,, J. A. Ross, Medical Officer, 1st September, 1921.
,, C. J. Caddick, District Surgeon, 15th June, 1921.

NURSING SISTERS.

Miss D. M. Kenny, 18th August, 1921.
,, F. M. Biggar, 24th November, 1921.

EUROPEAN CLERK.

Mr. T. R. Wilson, from Dispensers' Roll, 1st December, 1921.

ACCOUNTANT.

Mr. D. S. Wardle, 1st April, 1921.

SANITARY INSPECTOR.

Mr. D. P. Broad, 10th June, 1921.

ASSISTANT MATRON, LUNATIC ASYLUM.

Miss E. Hamilton, 1st February, 1921.

WARDER, LUNATIC ASYLUM.

Mr. F. J. B. Jordan, 4th February, 1921.

SUB-ASSISTANT SURGEONS.

Mr. Kishen Singh, 17th March, 1921.
,, Ram Singh, 20th March, 1921.

COMPOUNDER.

Mr. Gurdit Singh, 12th April, 1921.

NON-EUROPEAN CLERKS.

Mr. C. R. Lobo, 1st November, 1921, transferred from Audit Department.
,, C. C. de Souza, 1st April, 1921.
,, R. T. Ramos, 1st July, 1921.
,, S. M. Gomes, 15th November, 1921.

3.—REDUCTIONS IN STAFF.

DEATH.

Compounder D. G. Pradham, 1st August, 1921.

INVALIDED.

Sub-Assistant Surgeon Kesar Chand, 16th April, 1921.
Clerk S. M. Pinto, 22nd May, 1921.
Compounder G. Maitland, 31st August, 1921.
Sub-Assistant Surgeon D. S. Tipnis, 20th November, 1921.

RESIGNATIONS, ETC.

Dr. A. D. Milne, C.M.G., Principal Medical Officer, retired, 6th February, 1921.
,, F. H. B. Norrie, 3rd May, 1921.
,, M. C. Wetherell, agreement expired, 19th December, 1921.
District Surgeon G. Cross, 31st May, 1921.
Mr. A. Brown, Asylum Warder, 23rd January, 1921.
,, A. E. W. Webb, Clerk, transferred to Land Department, 15th November, 1921.
Nursing Sister Miss L. Merryweather, 12th February, 1921.
,, ,, ,, J. D. Murdoch, 6th August, 1921.
Mr. C. F. Bickell, Sanitary Inspector, 30th December, 1921.
Clerk P. J. Fernandes, 11th May, 1921.
Assistant Surgeon A. Whittle, 31st May, 1921.
Issuer Medical Stores, R. H. Mehta, 2nd June, 1921.
Sub-Assistant Surgeon C. D. Rana, 9th July, 1921.
Compounder M. A. S. Rodrigues, 22nd August, 1921.
,, A. J. Dave, 13th September, 1921.
Sub-Assistant Surgeon Anant Ram Sharma, 12th September, 1921.

4.—LEAVE OF ABSENCE.

Name.	Appointment.	Period.	
		Departed.	Returned.
Mr. C. E. Bickell	Sanitary Inspector	24th August, 1921	—
,, A. F. Dennett	,, ,,	12th February, 1921	8th November, 1921
Dr. V. M. Fisher	Medical Officer	26th November, 1921	—
Mr. E. Holness	Sanitary Inspector	11th November, 1921	—
,, R. C. Mills	,, ,,	24th August, 1921	—
Dr. T. H. Massey	Medical Officer	24th August, 1921	—
Mr. B. E. F. Wetkin	Sanitary Inspector	5th March, 1921	15th November, 1921
,, T. R. Wilson	Clerk	27th December, 1921	—
Miss R. Anderson	Nursing Sister	5th March, 1921	21st August, 1921
,, A. E. Davis	,, ,,	4th May, 1921	15th November, 1921
,, A. C. Leary	,, ,,	15th May, 1921	2nd September, 1921
,, V. B. Painter	,, ,,	15th May, 1921	2nd September, 1921
,, M. A. Perkin	,, ,,	12th February, 1921	5th August, 1921
,, R. K. Sharp	,, ,,	17th October, 1921	—
,, A. B. Wharin	,, ,,	27th December, 1921	—
,, M. I. Rhind	,, ,,	11th November, 1921	—

5.—RESUMPTION OF DUTY FROM LEAVE GRANTED IN 1920.

Name.	Appointment.	Date.
Mr. W. Henfrey	Superintendent, Lunatic Asylum	14th June, 1921.
Mrs. L. A. Henfrey	Matron, ,, ,,	14th June, 1921.
Dr. N. P. Jewell, M.C.	Medical Officer	19th January, 1921.
Dr. W. H. Kauntze, M.B.E.	Bacteriologist	16th September, 1921.
Miss F. L. Neave	Dispenser	28th February, 1921.
Mr. H. Ogden	,,	1st January, 1921.
Dr. J. Pugh	Senior Medical Officer	2nd September, 1921.
Mr. F. Strawbridge	Sanitary Inspector	20th July, 1921.
Dr. A. D. Williams, O.B.E.	Medical Officer	14th June, 1921.
Miss F. O'Neill	Nursing Sister	8th February, 1921.
,, I. Wilson	,, ,,	8th February, 1921.

6.—LEAVE.

Officer Absent Throughout 1921.

Dr. G. R. H. Chell, from 15th July, 1920.

7.—ADDITIONAL STAFF.

Mr. W. N. van Someren, a trained Naturalist, was engaged locally for a period of six months from the 1st May, to conduct investigations into the habits and species of rats and to make a collection of rat fleas for identification purposes in the Kavirondo district.

8.—LIBRARIES.

A medical library is maintained at the Laboratory and a lesser one at the Headquarter Medical Offices, both of which are available for reference by medical officers. Books are issued on loan to all medical officers who make applications. The libraries are added to by the purchase of the latest medical publications from time to time, whilst a varied number of scientific periodicals are regularly supplied.

SECTION II.—EXTRA DEPARTMENTAL.

9.—REGISTRATION OF MEDICAL PRACTITIONERS AND DENTISTS.

The Ordinance governing registration came into force on the 24th September, 1910. Since that date and up to the end of the year the following have been placed on the Register :—

Registered Medical Practitioners... ...	120
Licensed Medical Practitioners	6
Dentists	7

Seventy-three of the medical practitioners, including the Government Dental Surgeon, were registered for Government service, and 60 as private practitioners.

During the year 21 names were placed on the register.

The Board nominated for the purpose of the Ordinance consisted of :—

Dr. C. L. Chevallier,
,, A. R. Paterson,
,, F. L. Henderson,
,, H. H. V. Welch,
,, R. W. Burkitt,

with the Principal Medical Officer as President and Registrar.

No meetings were held during the year.

10.—THE DRUGS AND POISONS ORDINANCE, 1909.

This Ordinance controls the licensing of chemists and druggists as well as the sale of poisons throughout the country.

Twenty-one names have been placed on the register since the introduction of the Ordinance to the end of 1921. Of these 3 were by examination.

The Board appointed under the Ordinance consisted of the following :—

Dr. C. L. Chevallier,
,, A. R. Paterson,
,, F. L. Henderson,
Mr. V. H. Kirkham,
,, A. A. White,
,, L. A. Howse,

with the Principal Medical Officer as Chairman and Registrar.

No meetings were held during the year.

II.—PUBLIC HEALTH.

GENERAL REMARKS.

THE COLONY AND PROTECTORATE OF KENYA.

The year 1921 is chiefly remarkable from the fact that numerous candidates were forthcoming for the medical service, and at the end of the year there was only one vacancy in the strength of medical officers and medical officers of health. In all 13 new appointments were made, and so far it would appear that the new personnel is of a satisfactory type.

The accession to the strength, combined with the fact that only six of the staff were on leave at different times during the year, has rendered it possible to detach a striking force to deal with such outbreaks of serious infectious disease as have occurred, and this has undoubtedly contributed to the satisfactory condition of the public health which obtains with regard to infectious disease, as is shortly to be described, at the close of the year, while it has also enabled large strides to be made in the scheme for medical attendance in Native Reserves.

Weather conditions cannot, I regret to say, be described as satisfactory; there has been a general shortage of rain, and over almost the whole of the country both the large and small rains have been either very poor or have failed altogether. The close of the year sees the native population faced generally with a shortage of food and the almost certain occurrence of famine in various districts, notably the Giriama Reserve.

In spite of some degree of food shortage the public health of the Colony and Protectorate during 1921 can be described as highly satisfactory, and the close of the year is remarkable from the fact that the whole country is free from epidemic disease. An outbreak of small-pox occurred early in the year on the upper reaches of the Tana River. It was some time before the Medical Officer could arrive at the scene of action, but by April all was clear. No statistics are available, but it is certain that over 200 deaths occurred. The large outbreak of plague in North Kavirondo, which existed during the major part of 1920, died away completely during the latter half of 1921, as also was the case with the disease which existed in Nairobi itself at the beginning of the year, while several small outbreaks which occurred in South Kavirondo and in the Kikuyu Reserve in the Kyambu district were promptly dealt with and no extension took place. It is undoubtedly true that the type of plague which existed in the Kikuyu Reserve was of a low epidemicity, and in this connection I would refer to the very interesting facts and observations set forth in the Sanitation Section of the report, but I have no doubt that the prompt measures which have been possible owing to the presence of adequate staff have contributed in no small degree to the restricted spread of the outbreaks.

Anti-plague measures in North and Central Kavirondo have been systematized, and the campaign of education and preaching as to the etiology of the disease has resulted in the willing co-operation of the native. During 1920, when a Medical Officer was first appointed to North Kavirondo and it was found that an extensive epidemic was in being, the only possible anti-plague step which could be taken was the carrying out of wholesale inoculation. During 1921, a systematic and generalised rat campaign, as was referred to by the Chief Sanitation Officer in his report for 1920, was instituted in the North and Central Kavirondo Reserves, and the actual outbreaks have been dealt with by the inoculation of the inhabitants of the immediate locality, combined with measures of intensive rat destruction.

The saving of money is of course considerable, as up to the present it has not been possible to manufacture plague serum locally. While it is doubtless true that no country has yet been able to diminish its rat population by methods of rat destruction, yet it should be remarked that no country has hitherto been able to obtain the co-operation to this end of a whole population, as has been done in Kavirondo. The result of the experiment can only be of the greatest interest, and whatever may be the upshot with regard to plague, there can be no doubt that the resulting saving of foodstuffs will be enormous and at no cost to Government, as no reward is given for rats brought in. Efforts have been made to initiate a rat campaign among the Kikuyu, but the results have been disappointing, the population is more suspicious than the Kavirondo and more difficult to move, and the local superstitions are a formidable obstacle to the success of any measures aimed at rat destruction. A full account of anti-plague and anti-rat measures will be found in the Sanitation Section of the report.

Large additions to our knowledge of conditions affecting plague were made through the appointment for six months of a trained naturalist, Mr. W. N. van Someren, who made very interesting investigations concerning the rat population and its distribution in North Kavirondo. Mr. van Someren's report will be found under the heading "Sanitation," and his observations go far to show that the black rat (*Rattus rattus kijabius*) is chiefly concerned with the distribution of plague. The nomenclature of specimens of rats obtained will be confirmed by the British Museum. At the same time as rats were collected, so were their ecto-parasites obtained, and Mr. T. J. Anderson, the Entomologist attached to the Agricultural Department, kindly classified the large majority of fleas, with the courteous permission of the Honourable Director of Agriculture, and the remainder have been sent home for identification.

I regret to record the fact that the presence of kala-azar in the country has been definitely proved; two cases have come under observation during the year, one a cadet in the Administration, and the second a Somali woman, the wife of a K.A.R. askari. Both cases were definitely proved by the finding of Leishman-Donovan bodies in liver pulp, and both cases ended fatally. Both cases came from the Northern Frontier, and the presence of the disease there is not remarkable, as Leishmaniasis has been identified as occurring in the Soudan. Although it is not anticipated that there is much likelihood of a spread of kala-azar, yet its presence must be remembered in view of possible extension and the serious results which might accrue if such occurred.

Another interesting discovery and fortunately without the same possibly serious importance was the detection of the fungus *Monilia tropicalis* (Castellani), in a case of a European child suffering from what was clinically severe diphtheria, a disease which has so far not made its appearance in this country. Full reference is made to this in the Bacteriological Section of the report.

A case of infection with the *Sparganum Mansoni*, the first case recorded in this country was discovered at the Native Civil Hospital, Nairobi.

Cases of typhus have continued to occur. Detailed description of the cases, together with investigations carried out thereon will be found in the Laboratory Section of the report.

It will be noticed that the laboratory test was positive in all cases but one. No cases have yet been found among the native or Indian population, and the results of bacteriological tests made on cases of 93 undifferentiated fevers or taken at random among members of these sections have resulted in one case giving a reaction of 1 in 40 and 5 cases 1 in 10.

The reorganization of the King's African Rifles Medical Service has been practically completed and shows good prospects of success. The old civil dressers have been largely replaced by properly enlisted men who are written on at much reduced rates and are trained at Nairobi in the military hospital and drafted out to the various stations as required.

The influx of European population continued during the early part of the year, but died away later. A non-native census was taken on 21st April and the results were as follows:—

Europeans	9,651
Indians	22,822
Goans	2,431
Arabs	10,102
Others	627

European births and deaths totalled 255 and 90 respectively, as against 183 and 88 in 1920. Registration of births and deaths among the non-European population is not compulsory, and no figures are obtainable with regard to these.

Improvements have been carried out at the various hospitals with the dual object of increasing efficiency and effecting economy, and these will be fully dealt with under the heading "Hospitals."

Especial attention has been paid to the provision of facilities for the treatment of venereal disease, but I am of opinion that a large measure of educational work will have to be carried out before full advantage will be taken by the natives of even restricted provisions for treatment, and this is no exception to the experience which has been found among more civilised communities.

The appointment of a third bacteriologist has enabled more close attention being paid to the production of calf lymph with special regard to the conditions under which it is produced and the quality when issued. Great strides have been made during the year. It is hoped during 1922 that the erection of the ice plant at the laboratory will be proceeded with and an enormous saving of time and labour effected thereby, as it will no longer be necessary to destroy a large amount of prepared lymph as at present on account of the lack of cold storage.

An improvement which is likely to prove of lasting benefit has been made in the method of sewage disposal at Mombasa. Night soil instead of, as formerly, being dumped over the cliff on to the reef by means of a chute, irrespective of the state of the tide, is now discharged into deep water soon after high water from an underground tank and is rapidly carried out to sea. This and other improvements in the Mombasa Conservancy are described fully in the Sanitation Section.

The Public Health Bill, after having been recommitted to council for deletion of certain clauses, notably those relating to the segregation of races, received assent in September, and has already shown itself to be a useful measure.

The promulgation of the above Ordinance represents a most noteworthy event in the more recent history of the development of public health administration in East Africa.

In order that the significance of this enactment may be realised, and in order to show that it represents an actual progress in public opinion, it would seem advisable shortly to recount the steps which have led up to it.

In the early days of the East Africa Protectorate, now the Colony and Protectorate of Kenya, the energies of the Medical Officers attached to the administration were chiefly directed towards the maintenance in health of the European and native employees of Government. The practice either of curative or preventive medicine among the general native population was, on account of the paucity of the medical staff, the difficulties and dangers of transport and the backwardness of the native population, largely impossible, while the preventive work which these officers were called on to perform was limited to such as was necessary for the maintenance in a sanitary condition of small administrative stations, the population of which would not, as a rule, exceed half a dozen Europeans and fifty or a hundred native troops or police.

The practice of Medical Officers was, therefore, for the most part clinical, since there was but little other scope for their activities, and as the directions in which the country might develop were not then realised, they were not required to be specially experienced in those branches of preventive medicine and public health work, which are more particularly concerned with the avoidance of the insanitary conditions which are apt to be the concomitants of urban and industrial development.

Only later the development of urban conditions and the breakdown of natural quarantine which resulted from the opening of the Uganda Railway and the development of the road system, made it obvious that the activities of certain Medical Officers would require to be directed towards a new sphere of work. It was then further recognised that as this work was of a specialised nature it would only be satisfactorily carried out by officers with special training, and provision was therefore made in the estimates of 1913-14 for two whole time Medical Officers of Health and four European Sanitary Inspectors, in addition to the appointment of Medical Officer of Health, Mombasa, established some years previously. At the same time in order to provide for the correlation of the work and in order that more particular attention might be given to such subjects as town-planning, the prevention of epidemics and the duties and responsibilities of local authorities in relation to public health, a Chief Sanitation Officer was appointed and a Sanitation Division of the Medical Department came into being.

The organisation and establishment of the Medical Department in the year 1913 was, therefore, as follows:—

ADMINISTRATIVE.

Principal Medical Officer	1
Deputy Principal Medical Officer	1
Chief Sanitation Officer	1

EXECUTIVE.

(*a*) Medical Division:—	
Senior Medical Officers	2
Medical Officers	17
(*b*) Sanitation Division:—	
Medical Officers of Health	3
Sanitary Inspectors	4

With the exception of three Medical Officers who were on what was practically military duty in the Northern Frontier and Jubaland, two Medical Officers at the coast Ports of Kismayu and Lamu, and one Medical Officer at Fort-Hall, the whole of the above staff was distributed along the line of the Uganda Railway. One Medical Officer of Health was stationed at each of the three larger towns, while the Senior Medical Officers and Medical Officers were attached to the European or Native Hospitals in these towns and at Nakuru.

With the possible exception of the Medical Officer at Fort-Hall and two Medical Officers on Sleeping Sickness duty, there was no Medical Officer stationed in any of the Native Reserves.

A number of Asiatic Sub-Assistant Surgeons were distributed among the administrative stations of the Reserves, but chiefly with the object of providing some form of medical treatment for Government employees, and as the inclinations of these Sub-Assistant Surgeons were not, as a rule, directed towards the treatment and care of Africans, their services were never greatly in request, and the native population remained without medical treatment, while the District Administrative Officers were left largely without adequate advice or direction with regard to the improvement of the public health of the native populations under their charge.

In 1918 provision was made in the estimates for the appointment of 10 more Medical Officers of Health and 8 more Sanitary Inspectors to the Sanitation Division with the intention that these additional officers should work in the Native Reserves, and accompanied by travelling dispensaries should undertake the treatment of disease and the control of epidemics.

On account of circumstances resulting from the war, no appointments were made to these posts at the time, but the provision was not removed from the estimates, as every year it was becoming more fully realised, not only by Government, but by the European Section of the public that the institution and establishment of facilities for medical treatment and the control of epidemic diseases among the native population was a matter to be undertaken at the earliest opportunity. Not only was the provision allowed to remain, but additions were also made to the Medical Division of the Department, which by 1921 numbered 25 Medical Officers and Senior Medical Officers.

That these later additions were made to the Medical rather than to the Sanitation Division, indicates that it was now more fully realised that in order to carry out preventive measures in the Reserves the confidence of the people must first be obtained, and that such confidence could best be obtained by Medical Officers engaged primarily in the successful practice of curative medicine. The Medical Department as a whole was no longer considered merely as an organisation maintained by Government to facilitate administration by maintaining the personnel of the executive in health, but as a Department of Government responsible for the carrying out of one of the most important functions for which Government itself is established, namely, the maintenance in health of the general population of the country and the improvement of the conditions under which that population lives.

That this point of view was at last very fully accepted was undoubtedly partly due to an appreciation of the fact that the economic welfare and progress of the country is at bottom dependent on a numerous and healthy population, but in no small degree it was also the result of a realisation of the actual needs of the natives and of the debt that was due not only in consideration of taxation, but also for services rendered during the war.

It is chiefly as evidence of the general recognition of this point of view and only secondarily as an enabling instrument that the Public Health Ordinance of 1921 is of importance, and were that point of view not generally accepted, the powers conferred would be of no utility and the obligations and duties inculcated mere empty words.

The Ordinance itself is largely founded in the Public Health Act of the Union of South Africa, No. 36 of 1919, so modified as to be adapted to the different conditions which pertain in a part of Africa where the population is preponderantly native and where local self Government is still in an early stage of development. In drafting the Ordinance the old names have for a number of reasons been retained, but it is very clear from a perusal of the Ordinance as a whole and particularly of the section in which the functions of the Medical Department are described that that Department is no longer primarily concerned with facilitating the work of Government by treating and safeguarding its officials, but has become in fact a Department of Health, an executive branch of Government statutarily established, with definite functions and charged with the administration of a considerable body of law, while the old restricted Sanitation Division disappears and particular duties with regard to employees of Government are not mentioned.

The Ordinance states that " there shall be for the Colony and Protectorate a Department to be known as the Medical Department, which shall be under the control of the Principal Medical Officer and the functions of the Department are specified to be as follows :—

> " To prevent and guard against the introduction of infectious diseases into the Colony and Protectorate from outside; to promote the public health and the prevention, limitation or suppression of infectious, communicable or preventable diseases within the Colony and Protectorate, to advise and direct local authorities in regard to matters affecting the public health; to promote or carry out researches and investigations in connection with the prevention or treatment of human diseases; to prepare and publish reports and statistical or other information relative to the public health, and generally to carry out in accordance with directions the powers and duties in relation to the public health conferred or imposed by this Ordinance."

The Ordinance is comprehensive and such matters as administration, notification, prevention and suppression of infectious diseases, venereal diseases, the Regulation of Ports, leprosy, prevention of small-pox and the prevention and destruction of mosquitoes are dealt with in full and will require but little elaboration by regulations, while in Part IX., " Sanitation and Housing," it is laid down in detail what acts or things may be considered to be nuisances and powers are conferred with regard to the abatement of the same, not only in townships, but wherever they may occur. With regard to most matters, however, the Ordinance is not detailed, but instead wide powers are conferred on the Governor with regard to the promulgation of regulations.

Largely the Ordinance is an enabling instrument under which the Governor can make such regulations as may be required from time to time or repeal from time to time such regulations as may have become unnecessary.

As, however, the matters which may be dealt with by regulations are many, diverse and important and as in many instances large interests may be involved, an Advisory Board, termed the Central Board of Health, is also established in order to ensure that the possible effect of, or necessity for any proposed regulations may be fully considered before they are promulgated.

Furthermore, in order to prevent as far as possible the promulgation of inexpedient or ill-considered regulations or of regulations which, while suitable for a particular district or community, might adversely affect in an indirect fashion the inhabitants of a neighbouring district or the members of another community, it is also enacted that all regulations made by a Local Authority affecting the public health shall not take effect unless and until they have been submitted to and confirmed by the Board.

The most important feature of the Ordinance, however, is the organisation which is established for the safeguarding of the health of the population. For this purpose the present administrative districts of the country (save as excepted by the definition of Local Authority) have been accepted, and "district" is defined as meaning in relation to a Local Authority " the area which is under the jurisdiction of that Local Authority," while " Local Authority " for the purpose of this Ordinance is defined as the Council of any Municipality, any Committee or other authority appointed under the East Africa Townships Ordinance; and the District Commissioner of the district under his jurisdiction and the Medical Officer for such district when available (not being within the district of any existing municipal authority).

The general duties of local authorities are laid down in Section 14, which is as follows :—

> " It shall be the duty of every local authority to take all lawful necessary and under its special circumstances reasonably practicable measures for preventing the occurrence or dealing with any outbreak or prevalence of any infectious, communicable or preventable disease, to safeguard and promote the public health and to exercise the powers and perform the duties in respect of the public health conferred or imposed on it by this Ordinance or by any other law."

This section marks progress. Previous to its enactment there is no evidence to be gathered from the laws of the country that the care of the public health of an area was incumbent on any local authority save perhaps in the case of a Municipality. Powers there certainly were, but no duties had been laid down or obligations imposed.

From the above it follows that in a Native Reserve the responsibility for safeguarding the health of the native population lies with the District Commissioner and the Medical Officer acting together as one authority. While such an arrangement whereby the Medical Officer becomes a member of an executive authority is somewhat unusual, and on the whole foreign to English custom it represents probably the most satisfactory solution of certain difficulties which in the past have stood in the way of efficiency in undeveloped countries.

By the more Senior Administrative Officers of native districts the importance of the public health has always been realised, but by the more junior this has not always been the case, while at the same time junior Medical Officers with their zeal for efficiency have not infrequently combined a certain lack of a due sense of proportion and of the difficulties of introducing methods foreign to the civilisation of a backward community and have at times seriously inconvenienced Administrative Officers and rendered further progress in their own sphere more difficult than it need have been.

Provision is also made under the Ordinance whereby in the event of a Local Authority failing to exercise its powers or perform its duties in a satisfactory manner the Governor on the advice of the Board may appoint some person to perform the necessary duties, and provision is also made whereby the remuneration of the person appointed and the costs of the work carried out may be recovered by Government from the defaulting authority.

Apart from the sections dealing with the above contingency the Ordinance is not directly concerned with finance. Hitherto all Medical Officers, Medical Officers of Health, Sanitary Inspectors, etc., etc., have been appointed and paid by Government, and as there is as yet but one Municipal Corporation—and that neither a very old nor a very rich one—it is the intention of Government still to remain responsible for the appointment and payment of these officers. It was, therefore, unnecessary to include any financial provisions in the Ordinance in this regard.

The appointment of an accountant to the Medical Department is another innovation which has proved of the greatest benefit. It is now possible to keep a much closer check on expenditure, and with improvements which are being instituted generally in the system of rendering accounts from outstations it is hoped that a high degree of efficiency may be attained in this branch.

During 1921 great improvements were made in the conditions of pay of Medical Officers and Medical Officers of Health. The pay now rises to £900 per annum, and the introduction of two efficiency bars and compulsory courses of study between the grades should offer sufficient encouragement for the keen and efficient officer to maintain himself at a high standard.

The estimates as sanctioned for 1922 provide for the creation of a senior grade of Sanitary Inspector, and this effects an undoubted improvement in the conditions of service of this rank, who up to the present have been at a dead end with regard to pay and prospects. Although this improvement had to be associated with a decrease in the total staff originally budgeted for, it is anticipated that the increased incentive will lead to the performance of the necessary amount of work.

The numerous appointments which have been made in the medical staff have not been paralleled in the subordinate ranks; no candidates appear to be coming forward in India for appointments as Assistant Surgeons and Sub-Assistant Surgeons and the strengths of these are becoming inconveniently low. Were facilities in existence for the proper training of Africans I should feel less uneasy as to the future with regard to the subordinate ranks, as I am convinced that with proper selection of candidates and a systematic course it would be quite possible to train Africans to the necessary standard. Some three years ago money was provided by the Red Cross Society for the purpose of training Africans in medical work, and was offered by Government to the Church Missionary Society, who have this year decided to accept the offer—as yet no hospital is available for training purposes, and the staff so far consists of one medical man and one nurse. Kisumu, with its staff of Medical Officers and nurses and its large permanent hospital, lacks only one thing to become a teaching centre and that quarters where students can be kept under control and where habits of discipline could be inculcated. I propose, if it is at all possible during 1922, to endeavour to make a start with the means at my disposal in training a small class of the local native, but I feel that proper quarters are almost an essential.

The building of the new Nasin Gishu Railway will add during the next three years to the responsibilities of the Medical Department, as though the provision of proper medical facilities and sanitation is a duty of the contractors, yet the Government must see that the provisions in this respect are adequate.

The future general policy of the medical department is one which requires a few remarks. Up to the present it has been the custom for Medical Officers to be posted at such centres of European population as Nakuru and Eldoret. I am of opinion that owing to the changed conditions of the Colony this arrangement should as soon as possible be substituted for a system of district surgeoncies as obtains in South Africa. The present arrangement is undesirable for two reasons: (*a*) the Government pays full time salaries to Medical Officers, a large part of whose work consists in the treatment of non-official patients, *i.e.*, in private practice, and (*b*) the existence of Government Medical Officers in settled areas prevents the setting up of private medical men, who would be unable to compete with the salaried Government man in localities where there is not enough practice for two. I have been in communication with more than one private medical man, but so far have had no success in finding likely applicants for posts should such be instituted, but I anticipate that a revival in trade and better conditions generally in the country would be followed by the obtaining of suitable candidates.

NATIVE RESERVES.

As already mentioned, large strides have been made with regard to the scheme for the provision of medical facilities in Native Reserves. The two permanent buildings at Kisii and Machakos have been completed, and the end of the year sees them practically ready for use. These hospitals have been built on the pavilion system with an administration block and operating theatre in the centre and the wards on either flank, *vide* the accompanying plan. It will be noticed that ample space has been allowed for possible future extension of the administration block, and if in the future, as is desirable, these permanent hospitals become centres for research, space is available for the erection of a clinical laboratory.

Two entirely new centres have been opened at Chuka and Narok, and both of these have proved their usefulness.

The type of buildings which are in use at Chuka are wattle and daub, and were either in existence prior to the opening of the medical centre or have been erected with the co-operation of the local natives. The need for this centre is shown from the fact that two months only after its opening the daily average of patients is over a hundred. Up to the present almost the only disease for which treatment has been sought is yaws, and the incidence of the disease in this part of the country is no less than was reported last year in the case of Kikuyu and South Kavirondo.

Both at Chuka and Narok the staff consists of one European officer and a subordinate native staff. It is proposed ultimately to increase the sphere of usefulness of the Chuka station by the adoption of a system of out-dispensaries as is in existence in North Kavirondo, and as is outlined in my report for 1920. At Narok, owing to the nomadic habits of the Masai, I do not think it will be profitable to maintain more than a central hospital.

Machakos which, up to the present year, was only a sub-station in charge of one of the subordinate staff, has been converted into a headquarter station with a Medical Officer in charge, and a system of out-dispensaries is being inaugurated to serve the Ukamba Reserve. As I have already pointed out, a permanent hospital has been erected here.

The already existing centres, Kisii and Kakamega, have been largely increased, in the former case by the erection of a permanent hospital and in the latter by the addition of wattle and daub wards, bringing the accommodation up to 100 beds, all of which are kept full while, in addition, makeshift accommodation has to be found for such cases as necessitate urgent admission to hospital. At Kakamega the existing system of out-dispensaries has been increased to 18, all of which have done useful work throughout the year.

At Kisii the pressure of work entailed by the treatment of thousands of cases of yaws has not rendered it possible to establish out-dispensaries and the comparative absence of communications would, in any case, constitute a difficult problem to be overcome before an extensive system of such could be inaugurated.

The medical facilities at the old established stations, Kisumu and Fort-Hall, have been largely increased. At Kisumu out-dispensaries have been established, seven in number, in the Central Kavirondo district, and over three thousand patients have been treated at these during the three months of their existence. At Fort-Hall a yaws camp has been established outside the township boundary, accommodating over a hundred patients, and the benefit to the unfortunate yaws-ridden population has been incalculable. Three out-dispensaries have been also started in the Fort-Hall district.

In Central Kavirondo an interesting and instructive investigation has been embarked on with the object of ascertaining the fertility and infant mortality rates and the causes of infant mortality among the Nilotic Kavirondo. There is no doubt that the infant mortality among all tribes is exceedingly high, and the figures and data which will be obtained will be of the greatest assistance in the future when this subject, as it must, is grappled. An investigation of this nature was made some years ago in what is now the Tanganyika Territory, but the habits and customs of different tribes vary so widely that I am of opinion it will be necessary to obtain separate information for each locality.

The problem of the efficient running of a medical centre with its sub-stations in a Native Reserve is largely governed by the communications and means of rapid transport available. It is not enough to establish an out-dispensary with what can only be a partially trained boy in charge. Constant supervision is necessary or the dresser will become slack and the work neglected, and when once an institution gets a bad name among an African population, months of work will not suffice to restore the confidence of the people. In some districts, for example, both North and Central Kavirondo, the means of communication are excellent and abundant, but the type of motor conveyance which is supplied for the use of Medical Officers is, I regret to say, old, inefficient and expensive. It is hoped, however, that this will be remedied before long.

There has been no increase in the number of missions subsidized during the year and no applications for such were received. The two subsidized branches of the Church of Scotland Mission situated at Kikuyu and Tumu-Tumu have continued to do good work and the following numbers were under treatment during the year (excluding those treated by native dressers at out dressing stations) :—

Kikuyu	5,139
Tumu-Tumu	8,590
Total ...	13,729

I would again point out the desirability of Government itself undertaking the medical work in the reserves rather than subsidizing missions to do it for them. The work in Government units can be standardized and kept to a high level, and politically it is important to show the native that he is something more than a mere tax-payer. A Government hospital is a tangible sign of Government activities which is understood by every native, but it is doubtful whether a subsidized mission hospital is in any way connected in the minds of the majority of the patients as being anything more than a token of the benevolence of the missionaries who therefore reap the credit and the resulting influence. It is a fact which cannot be gainsaid, that the provision of medical attendance, even of the crudest and most primitive description, is the best form of advertisement for any form of activity among natives, from labour recruiting to missionary work, and therefore every penny of Government money which is available for medical work should be spent by Government rather than by any independent body, and the resulting kudos would thereby be obtained by Government.

In the 1921 estimates the vote for medical work in Native Reserves, which in 1920 was a one line vote for £7,860 under the heading " Medical Mission Units," was split up into two, of which one amounting to £3,537 was allocated to the subsidizing of missions, and the second, amounting to £5,306, to be spent by the Medical Department. Of these two sums only £2,372 were spent in the first case, as no new missions were subsidized, and of the second, £4,294, but this figure is erroneous, and should be larger as such items as " Carriage of Goods " and " Local Travelling," in connection with medical work in Native Reserves which should properly have been included, have been charged against the separate votes under these heads in the estimates. With the improvements already instituted in the accounting branch of the Department it is hoped that these items will be charged in future to the proper head.

The valuable nature of the work being carried on in the reserves is well shown by the total, 33,958, of cases treated at the two stations, Kakamega and Kisii, which have been in existence throughout the year and from the fact that over 20,000 cases of ulcers have received treatment and been discharged cured in North Kavirondo and 3,321 cases of yaws in Kisii.

An interesting experiment, and one likely to be fraught with large possibilities, will shortly be undertaken at Kakamega, where it is proposed to start a lying-in ward. It is not expected that at first the accommodation provided will be extensively patronized as it will first be necessary to undermine the influence of the old women, who at present in these and other matters are all powerful. Up to the present, even, occasional cases of difficult labour have been brought to hospital, and if the lying-in facilities can be at all popularized it may be possible in the future to train midwives for work in the villages.

SANITATION.

(i.) STAFF.

Three Medical Officers of Health, eight qualified and six unqualified European Sanitary Inspectors and two Nursing Sisters were engaged on whole time duties in connection with Public Health Work in the three larger towns throughout the year.

In addition, much sanitary work, and more particularly work in connection with the prevention and control of plague, has been carried out by Medical Officers stationed in the native reserves where the establishment of hospitals and dispensaries has enabled the confidence of the people to be obtained and so rendered possible much preventive work which could not previously be attempted.

(ii). LEGISLATION DURING 1921 AFFECTING THE PUBLIC HEALTH.

(1) The Public Health Ordinance, 1921, became law during the year.

No regulations were issued under this Ordinance during the year, but comprehensive draft regulations dealing with drainage, shipping and the control of milk supplies are in course of preparation.

(2) Under the Townships Ordinance, 1903.

Numerous rules were applied to various Townships, and Eastleigh, Rumuruti, Voi, and Kitale were declared townships, while the township boundaries of Mombasa were altered and those of Eldoret were extended.

(iii.) PREVENTIVE MEASURES.

MOSQUITO AND INSECT-BORNE DISEASES.

MALARIA.

Recorded cases (Government Hospitals and Dispensaries).

Year.	Cases.	Deaths.
1916	18,238	33
1917	17,968	38
1918	21,194	42
1919	20,778	42
1920	18,195	42
1921	17,253	27

The above figures are of little interest save in as far as they may indicate that there was no unusual incidence of the disease during the year. The usual routine, bush clearing, grass cutting, ditch clearing and oiling were carried out where necessary, and considerable progress was made in the improvement of the lake-shore at Kisumu. An extensive survey was made in North Kavirondo with regard to the splenic index of the populations of different inland areas, but the considerations of this is held over until a similar survey which is in progress with regard to the peoples inhabiting the lake-shore has been completed. It is unfortunate that owing to the fact that there is no professional entomologist on the staff of the Medical Department, a very complete malarial survey of the province will not be possible.

BLACKWATER FEVER.

28 cases and 5 deaths are recorded as compared with 13 cases and 4 deaths in 1920, and 47 cases and 21 deaths in 1919.

x ? x ?

TRYPANOSOMIASIS.

A Medical Officer was detailed for six months during the year with the object of investigating the present incidence of this disease among the population inhabiting the shores of the Victoria Nyanza, so far as these are included in this Colony.

A diagnosis of Trypanosomiasis was made in 103 instances. The diagnosis was arrived at on clinical grounds. Blood films and smears from gland juice were made in every case, but in only one smear were trypanosomes found. As it was not possible to keep any of the cases under observation, re-examinations were not possible. The diagnoses of Trypanosomiasis cannot, therefore, either be confirmed or disposed of, but a careful consideration of all the factors involved leads one to the conclusion that in a large number of instances the diagnosis was probably correct.

Fly was still found to be prevalent in all those parts of the shore where the conditions were suitable, and though most of these areas, which became deserted during the years of the great epidemic, are still uninhabited, to some the natives are beginning to return in small numbers. The Medical Officer who made this survey came to the conclusion that it would be by no means impossible to clear many of these fly infested stretches, and so render much valuable land safe and available for cultivation. It is hoped that it will be possible at an early date to carry out further investigations into this matter.

RELAPSING FEVER.

62 cases with 4 deaths are recorded as against 36 cases and 1 death in 1920.

EPIDEMIC DISEASES.

SMALL-POX.

An outbreak which was reported to have occasioned about two hundred deaths occurred in the isolated valley of the Tana in the administrative district of Lamu early in the year, and one case occurred in the Town of Mombasa.

As four cases were landed at Mombasa from vessels from Bombay, and the disease was present for a considerable period of the year, both in Zanzibar and in the Tanga District of the Tanganyika Territory, the country was fortunate in experiencing no other outbreak than the above.

VACCINATION.

58,909 vaccinations are recorded as having been performed during 1921. as against 139,753 recorded in 1920.

From these figures there would appear to have been a very large falling off in the number of vaccinations performed. It is doubtful, however, if that is actually the case to any considerable extent. As noted in last year's Report, the figures therein given were to a considerable extent compiled from the returns of native vaccinators who received but little supervision, and whose returns were in no way reliable.

During the past year, however, the practice of allowing native vaccinators to carry out work in the reserves without supervision was entirely discontinued. The numbers given in the table to be found in the Bacteriologist's report are compiled from returns rendered only by Medical Officers, Sub-Assistant Surgeons and Compounders, are therefore fairly accurate, and may be taken as records of work actually done. Further, as a great deal of attention was given during the past year not only to the preparation of lymph, but also to its transportation and storage, and as care was also taken both to ensure, as far as possible, that lymph issued was used within a specified time after receipt, and to ensure a satisfactory technique in operation, it is not improbable that at least as many, if not more, successful vaccinations were performed during 1921 as during 1920. Full details, with regard to many points of great practical interest and importance, are given in the Senior Bacteriologist's account at the end of this report.

THE ENTERIC GROUP.

42 cases with six deaths were treated at Government Institutions. The disease did not occur except in a sporadic fashion.

DYSENTERY.

Cases and deaths for past six years are as follows :—

Year.	1916.	1917.	1918.	1919.	1920.	1921.
Cases	3,321	2,529	4,401	2,626	1,151	1,174
Deaths	191	160	320	274	49	46

CEREBRO-SPINAL FEVER.

No outbreaks occurred. 71 cases with 41 deaths occurred sporadically throughout the country as against 60 and 33 respectively in 1920.

CHICKEN-POX.

984 cases are recorded.

MEASLES.

467 cases with 1 death occurred. The incidence was chiefly in Nairobi, and the type was mild.

MUMPS.

133 cases are recorded.

ANTHRAX.

34 cases with 2 deaths occurred. Cases and deaths from this disease are not infrequently reported by natives as plague.

INFLUENZA.

2,759 cases with 12 deaths were reported as against 4,797 cases with 43 deaths in 1920, and 2,278 cases and 111 deaths in 1919. As no definite outbreak occurred, and as the term is now frequently used to cover any febrile condition accompanied by catarrhal symptoms, the above figures probably considerably overstate the incidence of the disease.

TYPHUS.

8 cases are recorded with no deaths. All with the exception of one, in an Indian of good class, occurred in Europeans.

A close watch was kept in the native hospitals, but no case of the disease was observed amongst Africans.

As no insect has so far been shewn to be concerned in the transmission of the disease, preventive measures are not yet possible.

PLAGUE.

1. Incidence of the disease.

    Nyanza Province.
    Ukamba ,,
    Kenya ,,
    Naivasha ,,
    Seyidie ,,

2. Note on the commoner Rodents of Kenya and the bearing of their distribution on the incidence and spread of Plague.

3. Note on the rat fleas of Kenya in relation to the transmission of Plague.

4. Anti-Plague Measures.

    - General Remarks.
    - Measures in Townships.
    - Rat Destruction.
        - Kisumu.
        - Nairobi.
        - Mombasa.
    - Measures in Farming Areas.
    - Measures in Native Reserves.
        - Inoculation.
        - Rat destruction campaign in North and Central Kavirondo.
        - Tables shewing numbers of rats destroyed in North and Central Kavirondo.
        - Rat destruction campaign in the Kikuyu country.

5. Note on observations made during the execution of anti-plague measures.

6. Report on a Small Mammal Survey.

1. Incidence of the Disease.

Nyanza Province.

This province, which up till the end of 1920 was divided for administrative purposes into five districts, now consists of six. The area formerly known as the Kisumu district having been divided into two portions. The settled portion bordering on the Uganda Railway and consisting of farms and estates in European or Asiatic occupation retains the name Kisumu district, while the much larger portion which borders the lake-shore to the north of Kisumu and consists entirely of Native Reserve, is now called the Central Kavirondo district. The town of Kisumu lies in the Kisumu district.

Areas in which Plague has prevailed.

South Kavirondo Area.	2,800 sq. miles.	Pop. :	224,246.
Central ,, ,,	1,843 ,, ,,	,,	274,672.
North ,, ,,	2,669 ,, ,,	,,	301,727.
Kisumu District ,,	about 200 ,, ,,	,,	European and Indian farmers and some native labour.
,, Township ,,	about 18 ,, ,,	,,	about 150 Europeans, 1,000 Asiatics and 4,000 natives.

The first three districts mentioned are Native Reserves, and each is divided into about twenty smaller areas or locations. Each location is under the control of a native chief.

South Kavirondo.—As in former years plague in this district was confined to a few small and limited outbreaks as follows :—

About August 20th, at Kitutu's	6 deaths.
About September 2nd, at Wangare's, near Riana ...	15 deaths.
About September 22nd, at Kamada's, near Homa Bay	11 deaths.

Each of these outbreaks was dealt with by the Medical Officer of the district, the huts in the infected bomas being deroofed and left in that condition for some days while a certain amount of rat destruction was carried out in the neighbouring bomas. That no spread occurred is not, however, necessarily to be attributed to the action taken, which, on account of the fact that the people of this district are by no means "advanced" was necessarily of a very limited nature. These places are from 20 to 40 miles apart.

There is no evidence that the outbreaks were connected with each other in any way or that they were due to the introduction of the disease from another district.

Central Kavirondo.—During the first six months of the year a certain number of deaths from plague were reported, but as no Medical Officer was then available for district work, to estimate the number would be pure speculation. From the beginning of July onwards, however, a Medical Officer was stationed in the district, and accurate information is available for the rest of the year.

Shortly after this Officer took up duty in July, a message was received from the Indian community at Sio, a small trading port situated near the Uganda boundary in the Samia location, requesting him to visit the port as plague has broken out in the bazaar.

The Medical Officer's report on the outbreak dated 21-7-21, is as follows :—

" *Re* outbreak of Plague in the Samia district.

" *Sio Township.*—Rats were first observed dying here on 1-7-21. An Indian suffering from bubonic plague arrived here from Mjanji (in Uganda) on 3-5-21. On 6-7-21 a second Indian case of plague occurred here. Both cases died.

" No African case of plague occurred in the Township.

" *Mjanji Township* (*Uganda*).—Rats were first observed dying here on 28-6-21. Seven Indian cases have occurred since then. Eight Africans have died of plague in the Mjanji district.

" *Area round Sio Township.*—Rats have been observed dying in different villages for the past month or six weeks. I did not actually see a single case of plague in any of the villages I visited, but the chief and head-men informed me that about one hundred and fifty deaths had occurred from plague in the different villages during the past month. I consider that this estimate is high, as probably all deaths have been put down to plague. I am of opinion, however, that at least a hundred deaths from this disease have occurred during the past few weeks. The chief and head-men also informed me that the outbreak is now dying down.

" PREVENTIVE MEASURES.

" *Sio Township.*—Sanitary Inspector Creighton is remaining in the district until further orders, and is to send frequent reports. The general sanitation of the town is being improved as far as possible. The bazaar has been turned out and thoroughly deratted, 104 rats being caught up to date. The old market has been pulled down, and a new one erected. Improved latrines are being dug and arrangements are being made for the disposal of refuse. The lake-shore is being cleared as far as possible.

" *Samia location.*—Destruction of rats has not been carried out as thoroughly in this location as in other parts of the district (a general campaign had just been instituted throughout the Central Kavirondo district), but a local campaign has now been started and the chief and all his head-men held a meeting which I attended.

" During the past week 8,885 rats have been destroyed. I was present at the destruction of several huts and the average number of rats for each hut was eight. Bush is being cut and the ground cleared round all the villages. Inoculation is being done only when necessary.

" CONCLUSION.

" Plague is probably endemic round both Mjanji and Sio, but I am of opinion that it assumed an epidemic character during the past month.

" Sio Township, however, was probably directly infected from Mjanji."

In August three further cases occurred in Sio Township. The Medical Officer's report, dated 20/8/21, is as follows :—

" I regret to report a fresh outbreak of plague at Sio. Three cases have occurred, two Indians and one native. The native and one Indian case have died, the deaths occurring on 16/8/21, the day of my arrival at Sio.

" The infection has again been brought from Mjanji in Uganda. The Indian who died arrived from Mjanji on the 13/8/21, and developed a bubo on arrival at Sio. The native who died had been sent to Mjanji and on his return to Sio developed plague."

The number of huts in the Samia location is 8,992. The number of rats destroyed during July, August and September was as follows :—

In July, 52,000, or an average of 5·8 rats per hut.
In August, 20,000, or an average of 2·2 rats per hut.
In September, 39,902, or an average of 4·4 rats per hut.

No further cases occurred in the Central Kavirondo district till October, when five cases are noted in the Sakwa location. The Medical Officer's reports with regard to this outbreak are as follows :—

> "2/11/21.—I regret to report that I have received information to-day that an outbreak of plague has occurred in the Sakwa location. Sanitary Inspector Creighton is now there and appears to have the outbreak under control. Five cases have occurred, three being fatal. The outbreak is confined to one boma. Rats were first observed dying on the 24th and the first human death occurred on the 26th. The boma has been thoroughly deratted, but only 4 rats were found in 16 huts. The grass has been removed from all huts and the contacts have been inoculated. I am proceeding there personally as soon a possible.
>
> "18/11/21.—No further cases of plague have occurred in the Sakwa location during the fortnight. . . . Two plague-infected sick rats were killed, B. pestis being found in smears. An extensive rat campaign has been carried on in the surrounding district.
>
> "It is difficult to state the source of infection."

No other outbreaks of plague were reported in the district during the rest of the year, and from our knowledge of the natives of this district and of the remarkable degree of confidence which it has since become evident they had very shortly acquired in the Medical Officer, and from the fact that this officer and a European Sanitary Inspector were practically constantly on tour in the district during the last six months of the year, there is good reason to conclude that none occurred.

North Kavirondo.—Between 1,500 and 2,000 deaths from plague were recorded as having occurred in this district in 1920, and at the end of that year outbreaks were still occurring.

The returns of deaths from the disease by locations and months during 1921 are shown in following table :—

Location.	Month.											
	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Wanga	68	92	—	—	—	—	—	—	160?	—	4	—
Marama	61	63	—	—	3	—	—	1	40	—	—	—
Mukulu	50	50	—	—	—	—	—	—	—	—	—	—
S. Kitosh	10	14	—	—	—	—	—	—	—	—	—	—
Ohayo	18	38	—	—	—	—	12	—	—	—	—	—
E. Kakamega	—	21	—	—	—	—	—	—	—	—	—	—
Kakamega boma ...	1	1	2	—	—	—	—	1	2	—	1	—
Bunyore	—	46	—	53	—	—	—	—	—	—	—	—
Waholo	—	10	19	—	—	—	—	—	117?	—	—	—
Wamia	—	—	—	—	8	—	—	—	—	35	7	—
Kisa	—	—	—	—	—	—	4	—	—	—	—	—
S. Maragoli	—	—	—	—	—	—	6	—	—	—	—	—
N. Maragoli	—	—	—	—	—	—	2	5	—	—	—	—
W. Kakamega	—	—	—	—	—	—	—	1	—	—	2	—
Total	208	335	21	53	11	—	24	8	319	35	14	—

Before considering the above figures and their significance, several points should be noted which apply not only to North Kavirondo, but in some degree to South and Central Kavirondo as well :—

(*a*) The size of the district—2,669 square miles.

(*b*) The number of the inhabitants—301,727.

(*c*) The state of civilisation of the inhabitants—the great majority are illiterate and are clad only in skins.

(*d*) That though many of the natives know that the disease which kills men and the disease which kills the rats are identical (or at least that rat mortality frequently precedes human mortality), they have not yet reached a point at which they will always report either to their chiefs or to the Medical Officer; the fact that rats have been dying in their huts, though when an outbreak of human plague which has been reported is investigated, a history of a previous rat mortality can always be obtained. One reason for this may be that as extensive rat mortality is by no means always followed by human cases it does not as a rule excite alarm.

(*e*) That though the chiefs, head-men and people have now great confidence in the Medical Officers, they do not always immediately report the first few cases of plague either to their chiefs or to the District Commissioner or Medical Officer even if they are recognised as such. As a rule it is not till the outbreak has attained some proportions and a number of huts and bomas are involved that it is realised that something unusual is occurring.

The above table which is compiled from figures supplied by native chiefs is not, of course, accurate. The larger figures probably exaggerate the number of deaths, as during an outbreak all deaths from whatever cause will be attributed to plague. The smaller numbers may be correct. It is probable also that a number of sporadic cases occurring in isolated bomas never come to our notice, though there is reason to believe that all outbreaks of any size are reported.

The only deductions which can be made from this table would seem to be as follows :—

(*a*) That during January and February a very considerable number of deaths occurred in certain locations.

(*b*) That during September a considerable number of deaths again occurred in some of the same locations.

(*c*) That a number of very small and limited outbreaks and a number of sporadic cases occurred in other locations.

(*d*) That at no one time were considerable outbreaks occurring over the whole district.

(*e*) That by the end of the year cases had ceased to occur.

The bearing of meteorological conditions on the incidence cannot be determined even approximately, as readings are only taken at Kakamega station and the climatic conditions in various parts of the district vary very greatly.

With regard to the incidence of the disease in rats it is worthy of note that at the Government station of Kakamega no month passed without one or more plague-infected rats being found in some part of the station.

The incidence of human cases as given in the table and the records with regard to the incidence of the disease in rats within the limited area of Kakamega station do little more, however, than indicate the necessity for research with regard to the epidemiology of the disease in this district.

Apparently rat plague was present at one time or another in most of the locations of the district, and at Kakamega it was present throughout the year. The conditions under which the people live are very similar over the whole area, and nowhere was there any lack of rats. It is not clear why in certain areas an epizootic and an epidemic resulted, and why in other areas the latter at least did not occur.

Certain observations of considerable interest which would appear to answer in part at least the question why no outbreaks occurred in the large location of North Kitosh are detailed on page 35.

Kisumu District.—Four Africans died of plague on an Indian farm near Kibos in February, and in August a further six cases occurred among natives on another Indian farm in this neighbourhood. The sanitary conditions on these farms were not very satisfactory. The whole area is now, however, regularly inspected and considerable improvement is becoming manifest. Rat destruction was carried out in all farm labour lines by a European Sanitary Inspector, and Barium carbonate was issued to the Indian owners for routine use. No more disorganisation of trade than was absolutely necessary was caused and the confidence of these farmers has to some extent been obtained thereby. There is no evidence that the outbreaks were connected either with the movements of people or of foodstuffs. The Kisumu district is contiguous to the Central Kavirondo district, and the rat population of the two areas may be considered as one.

Kisumu Township.—Four cases occurred in the Township during the year as follows:—

> On April 6th one of the African hospital dressers who lived in a room in a stone building in the hospital compound was found to be suffering from bubonic plague, and two other dressers who lived in an adjoining room developed buboes on the following morning. A fourth boy who worked outside the hospital, but lived with the first mentioned boy, developed plague at the same time. All had been living in Kisumu for some months. The building was a satisfactory one and not rat infested. A history of rats having died near the building was afterwards obtained. The only confirmation of this story lay in the fact that when a somewhat dilapidated grass-roofed hut in the immediate neighbourhood of the boys' houses was burned down, no rats were observed trying to escape. An intensive poisoning campaign was instituted throughout the town and no further cases occurred.

Summary of Plague Incidence in the Nyanza Province for the Past Three Years.

South Kavirondo, 1919, 1920, 1921.—Two or three very *limited* outbreaks in each year.

Central Kavirondo.—A number of considerable outbreaks in 1919 and 1920 and the first half of 1921.

Kisumu District.—A few cases in each year among Africans employed on the Indian farms.

North Kavirondo.—1919, plague appears for the first time at Mumia's. No Medical Officer was then stationed in the district, but it would appear that a large number of cases occurred during the year.

1920, considerable outbreaks continued to occur throughout the year The mortality is given in the annual report at about 1,500, but subsequent information suggests that this was an under estimate.

1921, a considerable mortality continues to occur in several locations in the early months of the year. Three considerable outbreaks also occur in September. Thereafter cases gradually cease.

Kisumu Township.—1919, 41 cases.

1920, 41 cases.

1921, 4 cases.

UKAMBA PROVINCE—INCIDENCE OF THE DISEASE.

Kiambu District.—During 1920 rodent infection and consequent human cases had occurred, both on the European coffee farms and in the Native Reserve. During 1921 no human cases occurred on the farms, though rat mortality was several times recorded. The number of cases in the Reserve was not large. The plague history of the year for the district is as follows :—

> *At the end of January* 80 dead rats were found at Thika on the Thika tramway in the inwards goods-shed. The infection in this instance may possibly have been derived from Nairobi, as it was subsequently ascertained that a large number of rats had died in a railway go-down in that town, from which considerable quantities of goods had been despatched to Thika.
>
> On May 28th dead rats reported on a coffee farm near the Native Reserve; no human cases followed.
>
> On May 31st dead rats (B. pestis present) were found on a farm near the Native Reserve; no human cases followed.
>
> On June 1st a dead rat (probably infected) was found at Kiambu Government station in the porter's lines; no human cases followed.
>
> On June 15th a dead rat (plague infected) from Waweru wa Mahuis' location in the Native Reserve was found to be plague infected. On investigation no human cases could be discovered.
>
> On 17th August seven deaths among natives were reported in the Native Reserve near the Government farm at Kabete.
>
> On 7th September further deaths were reported from Kabete as having occurred in some huts about half a mile distant from those infected in August. A detailed report of this outbreak is given on page 59.

On 2nd December a report was made by a head-man from the Native Reserve between N'degwas and Karanja's locations that one death had occurred there on November 2nd, one on November 15th and one on November 28th. The history given was as follows :—

> Rats died on one side of a valley early in November and two deaths followed. An old native woman on the other side of the valley heard of the rat mortality, secured a dead rat and brought it to her own hut in the hope that the rats would died there also. A few days later (November 28th) her daughter died, and when the head-man dismantled her hut thirty-two dead rats were found.
>
> Very careful enquiries were made, and there seems no reasons to doubt the accuracy of the report. No further cases occurred.

On 7th December cases of plague were reported from Waweru wa Kanja's location near Mr. Knapp's mission. The outbreak was carefully investigated by a European Sanitary Inspector who remained on the spot for three weeks. The area involved covered about six square miles and 16 cases occurred. The results of the investigation of this outbreak are detailed on page 63.

In the last fortnight of December, seven sporadic cases occurred in the Native Reserve near Kinyanjui's boma.

Nairobi.—For the last few months of 1920 indigenous cases of plague had been occurring within and around the municipal area. Cases continued to occur during the early months of 1921 as follows :—

	Infected within the Municipal area.	Infected without the Municipal area.
January	28	8
February	23	16
March	13	4
April	7	1
May	—	—
June	2	—
July	—	—
August	—	—
September	—	—
October	—	—
November	—	—
December	—	—
	73	29

Of these cases 30 were found dead, and of these 19 are returned as bubonic and 11 as pneumonic. The latter term, however, must not be taken to indicate more than that no bubo was present while bipolar gram negative bacilli were found in smears from both the spleen and the lungs.

Details of the seventy-two cases treated in the Infectious Disease Hospital are as follows :—

Type.	Died.	Recovered.	Total.
Bubonic	30	17	47
Pneumonic	9	10	19
Septicaemic	6	—	6

With regard to the ten recoveries which are recorded against pneumonic plague, reference should be made to the Annual Report of the Government Bacteriologist.

In all cases a gram negative bipolar staining bacillus had been found, and on this, in the presence of the disease in the town, a positive diagnosis was made, and for administrative purposes the cases were treated as a plague. Further investigation has shewn that the diagnosis must be reconsidered.

RACIAL INCIDENCE.

European	2 cases.
Goan	2 ,,
Asiatic	8 ,,
Kikuyu	50 ,,
Kavirondo	18 ,,
Baganda	7 ,,
Other Africans	15 ,,
	102

From the above table, and from a study of the incidence of the disease according to locality, only one point emerges. The incidence of plague is governed in Nairobi as in other towns largely by the economic condition of the people. Cases among Europeans may be regarded as accidental, or as incidental to a particular occupation, those occurring among Asiatics—whose housing has within recent years been greatly improved—may also now be put in the same category.

The considerable incidence among Africans is, on the other hand, largely preventable. It is not, except in a very minor degree, incidental to occupation, but is the inevitable result of utterly inadequate and frequently very insanitary housing accommodation in a town where rodent plague is of frequent occurrence. The better paid Africans of Nairobi have established for themselves what is in many respects a model village, and they do not suffer from plague. The casual labourer, on the other hand, is absolutely unable to provide suitable housing for himself under urban conditions. The African housing problem is one of the most important matters before the Nairobi Municipality at the present time.

Kenya Province.—In the first week of December five cases of plague occurred among the African labourers on a coffee farm at Kubuku about seven miles from Thika. Dead rats had been found a few days previously. This was the first occasion on which plague had been reported from a farm in this area. There was no evidence that the infection had been brought to this farm at any time shortly before the outbreak either by goods or native, though it is always a possibility that infected fleas may have been brought to the farm from Thika when rat plague occurred at that station in January, ten months before. A more probable explanation would appear to be that the outbreak represented a natural spread among rats either from Thika or from the neighbouring Native Reserve which marches with the Kiambu Reserve, where the disease has been present for a number of years.

Naivasha Province.—Two cases of bubonic plague occurred on a flax farm five miles west of the Township of Nakuru in the month of October. Infected rats were found in the premises. No indication of the source of the infection could be obtained. No suspicious rat mortality had been observed at Nakuru. The possibility of infection existing among field rodents was considered, but could not be investigated at the time.

Seyidie Province.—One case occurred early in January in Mombasa, no rat mortality had been observed, and the occurrence is probably to be explained as an aftermath of the large outbreak which had occurred in 1920.

2.—NOTE ON THE COMMONER RODENTS OF KENYA AND THE BEARING OF THEIR DISTRIBUTION ON THE INCIDENCE AND SPREAD OF PLAGUE.

On page 26 of a Report on Sanitary Matters in the East Africa Protectorate,* Professor W. J. Simpson makes the following statement :—

> " In some of the Kavirondo districts the more intelligent natives associate the appearance of plague with the advent of a new species of rat which they call the Kisumu rat, which they declare is the only one which suffers from epidemics of rat disease. They have always had the field rat and the small black house rat, but the large dark brown rat which is found in the houses in Kisumu is, they assert, a new importation. It has reached as far as Yala in the north, but not Mumias, and Yala appears at present to be the northern limit of the prevalence of plague in this district."‡

---

* African, No. 1,025.
‡ *Vide* Fig. 3 and Fig. 4.

The above was written in 1913; the district referred to is roughly that now known as the Central Kavirondo district. Yala is situated on the Yala river which flows from east to west and was then the northern boundary of the district. The " large brown rat " mentioned by Professor Simpson is the " black " rat of East Africa, *Rattus rattus kijabius*, a sub-species of geographical race of *Rattus rattus rattus*, the old " black " rat of England. The " small black house rat " mentioned would appear to be the rat referred to below as the " multimammate," which, though dark in colour, is by no means black.†

Specimens have recently been sent to the British Museum, but have not, at the date of writing, been identified. They would appear, however, to belong to the genus *Rattus*, and to be nearly related to the species coucha.*

Plague did not occur at Mumias till 1919, six years after the date of Professor Simpson's note.

In April, 1921, during the course of an inspection of the North Kavirondo district, some observations were made which tended to confirm the statement made by Professor Simpson in 1913. The matter appeared to warrant further investigation, and it was decided to carry out a careful survey of the distribution of the commoner rodents of North Kavirondo, and at the same time to make a collection of their ectoparasites. The Department was fortunately able to secure the services of Mr. W. N. van Someren, who had been collecting elsewhere in the country. The results of his survey of the domestic rodents of North Kavirondo are shewn on the accompanying map (Figure 1).

If this map be compared with the next map showing the present distribution of the incidence of plague in North Kavirondo (Fig. 2), it will be seen that in those areas to which the black rat has not yet penetrated, plague does not at present occur.

The results of the rodent survey in North Kavirondo may be summed up as follows :—

It was found that in the huts in the north-eastern part of the district, *i.e.*, in that portion towards Mount Elgon there were no black rats but only the " multimammate." In that portion of the district no cases of plague have yet occurred.

Further south towards Kisumu and further west towards the lake-shore both kinds of rat were found in the houses, while still further south and west the " multimammate " rat was found to have disappeared, and the only domestic rat was the black one. It would appear that in this district the black rat is slowly extending his domain, taking his disease of plague with him as he goes. In certain parts of North Kavirondo his advent is so recent that plague is as yet unknown, further south the first advent of plague and the previous invasion of the district by the black rat are still remembered. Nearer Kisumu the advents of both have been forgotten.

Little more is definitely known with regard to the arrival of the disease in the Lake Basin than that it was there before the Railway reached Kisumu. It may have been there for centuries. It may have arrived viâ the Nile. The route by which the black rat arrived in East Africa is equally unknown, nor do we know whether he was the rat that originally brought plague to the shores of the Nyanza. All that is certain is that he has been in Kisumu for many years (but whether before the advent of the Uganda Railway or not is also unknown), that he has gradually spread throughout the Central Kavirondo district, and is now spreading over North Kavirondo, and that he is, so far as Kenya generally is concerned, the only rat associated with plague. He is also the rat of the Nairobi and Kiambu districts, and according to native accounts is not the original domestic rat in these areas. Twenty years ago they did not know of him. They say he came from Nairobi. He may have reached Nairobi either from Mombasa or from Kisumu, and plague also may have come with him to Nairobi from either of these two places.

---

† A few specimens of this " multimammate," which might rightly be termed " black," have been found in huts in the more northerly parts of North Kavirondo. They are, however, rare. It is not yet known whether they represent a species distinct from the rat referred to as the " multimammate " or not.

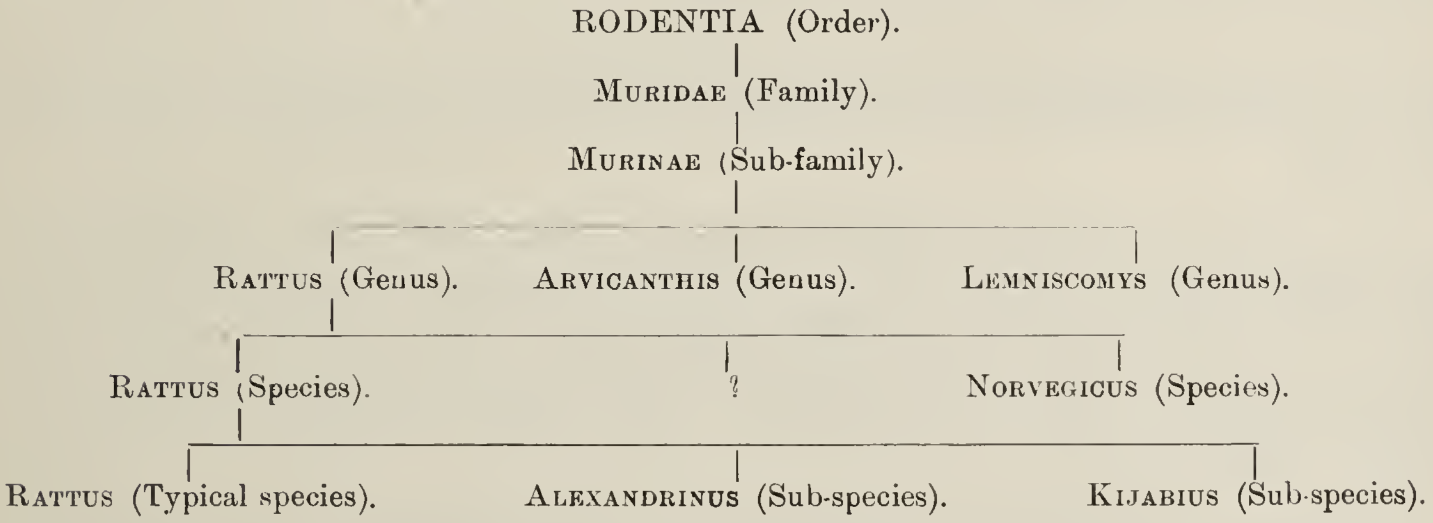
* Probably *Rattus coucha ugandae*.

The bearing of these facts on the epidemiology of plague in Kenya is not yet clear. Further information, particularly with regard to the rodent population of other countries bordering on the Victoria Nyanza and the Basin of the Nile is required.

So far as we know at present, however, plague in Kenya (apart from Mombasa, where *R. norvegicus* probably plays a part) is only associated with the black rat (*Rattus rattus kijabius*)[*]

A table of the classification of the commoner East African rats with a short description of each species is given below as it contains information which is not readily accessible elsewhere. A copy of a short note by Mr. van Someren with regard to his survey will be found at the end of this section.

CLASSIFICATION OF RATS.



Rattus norvegicus (formerly called *Mus decumanus*) = The common "brown" rat of England—the sewer rat (probably occurs in Mombasa, but is not known to occur elsewhere in Kenya).

Rattus rattus rattus (formerly called *Mus rattus*) = The old "black" rat of England—the ship rat.

Rattus rattus alexandrinus (formerly called *M. alexandrinus*) = The "black" rat of North Africa.

Rattus rattus kijabius = The common "black" house or hut rat of certain parts of Kenya (Mombasa, Nairobi, Kisumu, the Central Kavirondo district, most of the North Kavirondo district and parts at least of the South Kavirondo district, the Kyambu district, the Nairobi district, Kijabe, Magadi and probably all places on the Uganda Railway).

Rattus coucha ugandae (the "multimammate" rat) = The old hut rat of Kenya. (In the Nairobi, Kyambu and Central Kavirondo districts and throughout most of the North Kavirondo district this rat would appear to have been driven out of the huts and replaced by the "black" rat, *Rattus rattus kijabius*. In the north-eastern parts of North Navirondo, however, where there are no "black" rats, it is still the common and practically the only hut rat. Various sub-species of this rat are also to be found living wild, apart from huts in most parts of the country.)

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[*] See, however, Annual Medical Report for Uganda, 1921. In that Protectorate rats of the multimammate species would appear to have been concerned in the propagation of plague in some instances. The same is also the case in South Africa, where Mitchell records the occurrence of the infection among multimammate "mice" (*Rattus coucha*) on a farm. Jl. of Hyg., 1921., Dec. Vol. 20, No. 4.

Lemniscomys = The striped field or grass rats. (Found all over the country.)

Arvicanthis = The commonest field or grass rats. (Found all over the country.)

NOTES ON THE CHARACTERISTIC APPEARANCES, ETC., OF RATS.

Rattus rattus rattus and *Rattus rattus kijabius* are practically identical in size and in appearance; they can only be differentiated by a careful examination of the formation and shape of the molar teeth. The former is the black rat of England and the latter the black rat of Kenya.

This rat is of medium size; its general build elegant and slender; the muzzle is sharp.

The ears are very large, translucent and almost naked; if pressed forward they will reach or cover the eyes.

The tail is slender, at least as long as, and often considerably longer than the combined length of head and body.

The fur is soft, but intermixed in adults with many long slender bristles, which impart a somewhat harsh quality and bristling appearance to the coat as a whole.

The colour is as a rule dark, and rather of a slatey shade, though older individuals may be more brownish. The fur of the belly is, in some instances, of a much lighter, greyish or lemon colour, and this is particularly to be noticed in specimens from the Nyanza Province. Occasionally specimens of a reddish brown colour are captured. In no case, however, is the colour actually black.

Mammae.—The females normally have ten mammae, *i.e.*, two pairs on the chest and three towards the groin.

Distribution and Habitat.—Nairobi and district, Kiambu district, Mombasa, Kisumu and most of the Kavirondo country, etc., etc.

In grass huts it lives and nests almost entirely in the *roof*, or in the grass bed if there is one. It may also be found in native grain stores; in towns it is to be found nesting and living among boxes, crates, hides, etc., etc., in stores and go-downs, in the roofs of houses, behind matchboarding, and in *defective* plinths and under wooden floors, *i.e.*, it takes advantage of *existing spaces.* It does not burrow if it can avoid it.

Rattus rattus alexandrinus is very similar to the above; it is not definitely known whether this sub-species occurs in Kenya.

Rattus norvegicus (*Mus decumanus*).—The common brown rat of England. The sewer rat.

Size.—Larger than *Rattus rattus rattus* or *Rattus rattus kijabius;* general build heavy and rather clumsy; muzzle blunt.

Ears small, thick and opaque, covered with fine *small* hairs; *scarcely reach the eyes when pressed forward.*

Tail stout, *never as long as the combined length of head and body.*

Fur softer than in *Rattus rattus.*

Mammae.—Normally twelve, *i.e.*, six pairs.

Colour.—Brownish.

Distribution and Habitat.—A large rat which is probably *Rattus norvegicus,* is fairly common in Mombasa, to which place it was probably originally imported by ship. *It does not occur in Nairobi or Kisumu, nor in the Reserves.*

Rattus (coucha)?—The " multimammate " species.

There are several sub-species of this rat in Kenya. In the north-eastern part of North Kavirondo the most common hut rat is of this species.

It was probably at one time the common and only hut rat of the whole of the North and Central Kavirondo districts and of the country generally. It is not now found, however, in the huts in the Central Kavirondo district, nor in the greater portion of the North Kavirondo district, nor in the Nairobi district, as it has in these areas been driven out of the huts and replaced within very recent years by the black rat, *Rattus rattus kijabius.*

Numerous sub-species are still to be found, however, in the fields and bush over the whole country.

Size.—Smaller than the black rat.

Tail.—Shorter than the combined length of the head and body.

Colour.—Dark grey.

Mammae.—Usually twenty, *i.e.*, ten pairs.

Habitat.—The sub-species affecting native huts lives and nests in *burrows in the walls, not in the grass of the roof.*

Arvicanthis.—The common field or grass rats.

Size.—Smaller than the black rat; much more stoutly built; muzzle blunt.

Ears.—Short, hairy and opaque; there is a tuft of hair immediately in front of the ear, presumably for the purpose of preventing the entrance of earth or dust when the animal is digging.

Tail.—Short, only about half the length of the body.

Fur.—Coarse.

Colour.—" Pepper and salt," due to the fur consisting of black hairs with yellow tips.

Distribution and Habitat.—Found all over the country, but not in the centres of towns. It is essentially an animal of the country side. Though frequently found in native grain stores and occasionally trapped in huts, it does not as a rule nest in those situations. The specimens so found have in most instances only entered the granary or the hut in search of food.

Lemniscomys.—The striped grass or field rats.

Size.—Much smaller than *Rattus.*

Tail.—Slender; longer than the combined length of the head and body.

Colour.—The body fur is arranged in longitudinal black and yellow stripes.

Distribution and Habitat.—Found all over the country. Lives and nests only in the fields.

3. NOTE ON THE RAT FLEAS OF KENYA IN RELATION TO THE TRANSMISSION OF PLAGUE.

The following determinations have been made from time to time during the past five years, but have not hitherto been recorded in these reports.

Mombasa.—165 fleas from 24 domestic rats (*Rattus rattus* and *Rattus norvegicus*) have been identified as follows :—

Xenopsylla cheopis	38
Xenopsylla brasiliensis	126
Ctenocephalus felis	1
	165

Nairobi.—130 fleas from 32 domestic rats (*Rattus rattus kijabius*) have been identified as follows :—

X. cheopis	56
X. brasiliensis	73
Ctenocephalus felis	1
	130

Kabete.—(Kyambu district, six miles from Nairobi.)

82 fleas from nine domestic rats (*Rattus rattus kijabius*) caught on the Government Experimental Farm, Kabete, and in the neighbouring Kikuyu Reserve, in January, 1921, were determined as follows :—

X. cheopis	3
X. brasiliensis	79
	82

Kabete.—(Kyambu district, six miles from Nairobi.)

43 fleas from nine domestic rats (*Rattus rattus kijabius*) caught during the removal of roofs from native huts in a plague infected area in the neighbouring Native Reserve in November, 1921, were determined as follows :—

X. brasiliensis	37
Echidnophaga gallinaceus	6
	43

The results of the examination of the Pulicedae collected by Mr. van Someren in North Kavirondo are given below. The hosts from which this collection was made have been forwarded to the British Museum as an identification could not, in all cases, be made locally. Full details of the distribution of these fleas among their respective hosts cannot therefore be given in this report. The following observations are, however, recorded now as they suggest a possible line of research.

From 59 domestic rats (*Rattus rattus kijabius*) trapped in huts, mostly in the immediate neighbourhood of the Kakamega Government Station, where rat plague was present throughout the year, 182 fleas were collected and have been determined as follows :—

X. cheopis	29
X. brasiliensis	123
Dinopsyllus lypusus	22
Ctenopthalmus cabirus	7
Ctenocephalus sp....	1
	182

From 43 domestic rats (" multimammate ") trapped in huts or near the location of North Kitosh, where plague has not yet appeared, 165 fleas were determined as follows :—

X. cheopis	1
X. brasiliensis	145
Dinopsyllus lypusus	17
Ctenocephalus sp.	2
	165

From 24 common field rats (*arvicanthis sp.*) trapped in the open in various parts of the district 59 fleas were collected as follows :—

X. brasiliensis	43
Dinopsyllus lypusus	7
Ctenocephalus sp.	9
	59

From 109 specimens of the less common field rats (*Rattus amalae, Rattus kaiseri*, etc., etc.,) trapped in the open in various parts of the district, 88 fleas were collected as follows :—

X. cheopis	7
X. brasiliensis	29
Dinopsyllus lypusus	44
Ctenocephalus sp.	2
	82

With regard to the above records the following points are to be noted :—

(*a*) The commonest rat fleas in Kenya would appear to be X. brasiliensis and not X. cheopis.

(*b*) X. brasiliensis would appear to be capable of transmitting plague from rat to rat and from rat to man, as at Kabete in the Kyambu Reserve is was practically the only flea recovered from black rats caught in huts in an infected area.

(*c*) X. cheopis not infrequently occurs in the towns of Mombasa and Nairobi and in and around the Government Station and trading centre of Kakamega in North Kavirondo, where considerable outbreaks of plague have occurred. On the other hand, X. cheopis appears to be rare in the Kikuyu Reserve (Kabete), where cases of human plague have only occurred in a more or less sporadic fashion, and is a very rare parasite of the domestic rat (the " multimammate ") of North Kitosh, where plague has not yet occurred. Further, X. cheopis is but an infrequent parasite of field rats, none of which have so far been found to be infected with plague in this country.

(*d*) It is only as a parasite of the black rat that X. cheopis is of more than infrequent occurrence.

Percentage figures are not given in the above notes as the numbers are too small, and the observations too limited. Much larger collections from all parts of the country, and made at all seasons of the year will be required before conclusions can be drawn with regard to the exact rôle which any of the above genera or species may play in the transmission of plague in this colony. It is not unlikely that further investigations in this direction might provide some explanation of the fact that plague in Kenya has never, so far as is known, been as destructive as might have been expected when the climate, the conditions under which the natives live, and the very large rat population which is usually present are taken into consideration.

It is not obvious why the disease does not become epidemic in either the Kiambu or the South Kavirondo Reserves, nor why in North Kavirondo it has apparently never spread by being transferred to the original domestic rat (the " multimammate " of that country, but has only appeared subsequent to the displacement of that rat by *Rattus rattus kijabius.*

No observations with regard to the relative importance of the rôle of X. brasiliensis in the transmission of plague can be found in the literature available, and the question arises whether X. brasiliensis is as effective an agent in the transmission of the plague bacillus, either from rat to rat or from rat to man, as X. cheopis.

In this connection reference should be made to page 63 where there are detailed certain observations made in the course of dealing with infected huts, which would appear to suggest that under certain circumstances, X. brasiliensis is a comparatively inefficient agent in the transmission of plague from rat to man.

Xenopsylla astia, which from the observations of Cragg, would appear to be the common rat flea of those parts of India which are not affected by plague has not, so far, been recorded in East Africa.

Mr. T. J. Anderson, Chief of the Entomological Division of the Agriculture Department by the courtesy of the Hon. Director of Agriculture, very kindly undertook the identification of all the specimens referred to in the above notes, and the Medical Department is very greatly indebted to him for the time and trouble expended on the collections.

4.—ANTI-PLAGUE MEASURES.

General Remarks.—In endeavouring to estimate the effect of measures which have been taken in the past or the probable effect of any new measures which it may be proposed should be adopted with the object either of limiting the extension of plague or of securing its eradication, there are a number of points to which consideration must be given.

Among the more important of these are the following :—

(*a*) The large area of country in which the disease is at present apparently endemic—between 7,000 and 8,000 square miles.

(*b*) The conditions under which the natives live—in wattle and daub huts thatched with grass and with grain stores of similar construction in the immediate neighbourhood.

(*c*) The large rat population of the country—each hut may be expected to harbour from 5 to 15 rats.

(*d*) Leaving out of account *Rattus norvegicus* which is confined to Mombasa, there are as far as is known at present only two domestic rats in the country—the black rat, *Rattus rattus kijabius*, and the old hut rat, the "multimammate." Neither of these rats is ever found elsewhere than in buildings or huts, and the black rat alone appears to be associated with plague.

(*e*) The extension of the disease which has recently taken place in North Kavirondo has only occurred subsequent to a *natural spread of the black rat* over an area where it was previously unknown. In so extending its area of occupation the black rat would appear entirely to displace the "multimammate," as though "multimammate" rats are to be found in the field all over Kavirondo, the specimens so obtained appear to be of a different sub-species from that found in huts. There is no evidence that the extinction of the "multimammate" is the result of its being killed out by plague transferred to it by the black rat, nor is there any evidence that the extension of the area of occupation of the black rat is due to migrations caused by rats fleeing from the epizootic. It is to be noted that the black rat does not take up the same situations in the huts which it invades as were occupied by the "multimammate." The black rat invariably nests in the grass roof, or in the grass bed if there is one, while the "multimammate" invariably burrows in the mud and wattle walls.

(*f*) No field rodents have so far been definitely proved to be infected with the disease in this Colony.

(*g*) Though numerous outbreaks of plague are recorded in this report as having occurred during the year in the Kiambu and Kenya districts on farms and at certain points in the Reserve for the first time, it is unlikely that these represent an extension of the Highland endemic area. It is only within recent years that the Kikuyu native has shown any willingness to report outbreaks of disease, and as the black rat has been present in this part of the country for many years, and as there are records of outbreaks of a disease which would appear to have been plague having occurred in the Highlands so long ago as 1897, there would seem to be some reason for supposing, not that an extension is taking place, but that outbreaks now come to the notice of the Department, whereas in previous years these were not customarily reported.

(*h*) But little information is available with regard to a number of important points, *e.g.* :—

It is not known how plague is "carried over" in East Africa, or why in South Kavirondo and in the Highlands the disease only occurs in a sporadic fashion.

It is not known whether the disease may not previously have been a more serious matter in those areas than it is now, nor if so, to what factors its present comparative quiescence may be attributed.

It is not known whether the outbreaks which occurred previous to the advent of the railway were associated with the black rat or with another species.

The present distribution of the black rat outside a few areas is unknown.

The rôle of Xenopsylla brasiliensis in the transmission of the disease has still to be worked out. It is, however, possible that the native population in certain parts of the country has up to the present suffered much less severely from the disease than might have been expected, not only because X. brasiliensis may not readily bite man, but because X. brasiliensis in common with other insects may be distinctly disinclined to bite man when he is copiously anointed from head to foot with a mixture of red earth and castor oil. The substitution of soap and water for oil and of cotton blankets for skins is not therefore necessarily a sanitary improvement, while the housing of the people remains primitive to a degree.

Lastly, practically no information is available with regard to the factors which govern the movements or migrations of rats either in the presence of the infection, or in its absence.

(*i*) It is also to be remembered that the disease is endemic in parts of the neighbouring territories of Uganda and Tanganyika.

When the above circumstances are taken into account the possibility of eradication does not seem hopeful, and even the problem of control would appear to present almost insuperable difficulties.

It is not easy to see how extensive migrations of rats over a country side are to be prevented, nor at the first glance is it obvious how it would be possible even with the largest staff adequately to deal with an apparently unlimited number of foci of infection widely scattered over the large areas of the Native Reserves, nor would it be easy to justify the incurrence of any large expenditure in the attempt. Fortunately an experiment in rat destruction which is now being carried out in the North and Central Kavirondo districts suggests not only that neither eradication nor control may be impossible, but that an attempt to secure both may be made in Kavirondo at least without any expenditure being incurred by Government. The details of this experiment are given in full on pages 50-58.

One point remains to be recorded. If anti-plague measures are to be carried out in a Native Reserve, it is necessary both that we should have the willing co-operation of the people and early information with regard to all outbreaks of the disease that may occur. Further, the circumstances are such that any measures which may be taken are comparatively useless, unless they are general. It must never be forgotten that isolated cases of plague among humans are usually indices of a much more widespread infection among rats. In the past, plague-infected huts in Native Reserves, both in this Colony and in others, have on occasion been dealt with by burning, and the method is even advocated in certain text books of tropical medicine. Undoubtedly destruction by burning is a most satisfactory method of dealing with the actual infected grass hut, but unfortunately it is also the most satisfactory method of ensuring that no further reports of cases will be received from that area for a long time to come, and if due care be not taken to surround the hut with natives and to prevent any rats from escaping, it may also be a very efficient method of spreading the infection. It is a method, therefore, which should never, under any circumstances, be adopted with regard to a native-owned hut in a Native Reserve, or in a native town, nor should a chief or head-man be allowed or encouraged to burn infected huts. It must be remembered that even a native hut is not built without time, money and trouble, and that at certain times of the year it is actually impossible to find roofing materials for a new one. Also the owner may have certain predilections with regard to that particular hut or certain prejudices with regard to the destruction of any hut by fire. These prejudices or predilections must be respected; they are not necessarily always overcome by monetary compensation, which is always an uneconomical and unsatisfactory business and never applicable over an extended area. It is to be remembered that by the burning of one hut the focus of infection has not necessarily been completely dealt with or even dealt with at all. The infection was not necessarily acquired in the hut where the case occurred. It may have been acquired in a neighbouring hut, and in any case it is probable that not one but that many neighbouring huts harbour infected rats. To be logical all the huts for half a mile round should be destroyed by fire, an impossible proceeding. If it is impossible to adopt radical methods over the necessary area the justification for very drastic measures in a small part of the area disappears, particularly if the measure is so drastic as to result not only in hardship but in future concealment.

Fortunately a less drastic alternative is available. The hut can be deroofed. If this be done, while a number of natives surround the hut, no rats should escape destruction. After deroofing, rat burrows in the walls and floor should be looked for, and if any are found they should be dug out. The grass removed from the roof need not be burned. The owner of the hut may be advised to burn it, but it should be left to himself. It is not absolutely necessary. If he leaves it exposed to the sun for a week or ten days it will suffice. He should also be told not to inhabit the hut during that time, and informed that before re-occupation the walls and floor should be carefully replastered with cow-dung and mud. If the natives of the area are sufficiently sophisticated to appreciate the reasons for the action taken and can be persuaded to deal in a similar manner with neighbouring huts, so much the better, but undue pressure should not be brought to bear on them.

Finally, the whole story of the connection between rats and fleas and plague should be most carefully explained to all the neighbouring inhabitants, reasons given for everything that has been done, and an attempt should be made to get them to institute as intensive a rat campaign as possible throughout the location. If Barium carbonate is available, poison baits may be laid in the huts. There would seem to be great possibilities in the utilisation of poison on a large scale, but care must be taken to prevent accidents among a population unskilled in the use of this method of rat destruction. In the first instance, poison should only be laid under European supervision, and on no account should baits be laid in any hut, if the owner object. Inoculation may be *offered* to the immediate contacts and to the inhabitants of any huts in the immediate neighbourhood, but no pressure should be brought to bear on the people in this connection.

Lastly, it is to be noted that it is rarely necessary to enforce any measures of quarantine and usually useless to try. One cannot quarantine rats. The less the people are worried and distracted by unpleasant operations, such as inoculation or unnecessary and useless procedures such as quarantine, the more likely are they to devote their energies to the much more important matter of destroying rats and the more likely are we to receive immediate notice of future outbreaks of the disease.

The above method of dealing with infected huts has been used on many occasions during the past year. In no instance has any native engaged in the process of deroofing the hut, or of removing belongings from the interior, or of digging out-runs become infected, nor have any further cases ever occurred in infected huts which have been dealt with in this fashion.

The only real difficulty which is encountered is the question of providing shelter for the people who are temporarily turned out of their huts. It is not always easy to make temporary shelters and care must be taken to see that women and children are provided for. If a number of bush tents can be provided they are always very greatly appreciated.

ANTI-PLAGUE MEASURES IN TOWNSHIPS.

Routine rat destruction by trapping has continued to be carried out in the larger townships as in past years, and in Nairobi in particular, Barium carbonate baits have been used on a considerable scale during the latter half of the year. It is impossible to be sure that any impression has ever been made on the average rat populations of the larger towns by the methods which have hitherto been used, but with further experience in the technique of using Barium carbonate baits it is hoped it may be possible to achieve not only more successful routine destruction, but even that it may be possible in the face of an outbreak of plague to carry out a rat poisoning campaign in so intensive manner over a large area as to prevent the disease from occurring in other than a sporadic fashion among the human population. Such a campaign was not possible earlier in the year when plague was present in Nairobi, as a sufficient supply of Barium carbonate was not available, and such poisons as could be obtained were of too dangerous a nature for use on a large scale.

During the latter half of the year, however, Barium carbonate baits have been used on a considerable scale, and would seem to have given satisfactory results. It is proposed to carry out a number of controlled experiments with the object of testing the efficacy of this poison, and the attractiveness and keeping qualities of baits made from the various native flours.

It is also proposed during the ensuing year to institute the Rodier system of rat destruction in the Island of Mombasa.

It would appear, however, that routine rat destruction in urban areas will always be somewhat unsatisfactory, and the prevention of outbreaks in towns liable to infection with plague is probably only to be secured by permanently separating the people from the rats. To this end more and better housing is required, and much expenditure on the renovation or removal of old and insanitary premises. Owing to the general financial depression but little has been achieved during the year, either in Nairobi or Mombasa with regard to the former matter, but in the direction of remodelling or improving unsatisfactory premises much valuable work has been accomplished under the direction of the European Sanitary Inspectors attached to the Health Officers in these towns. Such work is slow, but it has the advantage of being permanent in its effects, and as there is now much more efficient control of new building operations, both in Nairobi and Mombasa than was formerly the case, the leeway which has to be made up is now being slowly but steadily lessened.

The sulphur fumigation of grain and of hides and skins and cotton seed introduced into Kisumu from the surrounding districts and from Uganda ports has been continued as in previous years.

Some 13,417 inoculations with Haffkines' prophylactic were performed in Nairobi during the earlier part of the year when plague was present in the Township. Unfortunately the persons inoculated were not, in the majority of instances, those who were most likely to be exposed to infection. Unfortunately also there is apt to be a very decided tendency not only on the part of individual inhabitants but also on the part of the public, and of the authority responsible for the execution of preventive measures to consider that with the immunisation of individuals the situation has been dealt with.

It is much easier to inoculate or to be inoculated than it is to destroy rats or to renovate dilapidated and insanitary buildings.

In this connection it may be noted that by far the most useful qualification for the Sanitary Inspector in a tropical town is, as elsewhere, a sound practical knowledge of building construction. Not only will the sanitary notices issued by the Inspector with such training be sound and practical, but he will be able to assist the property owner to have the works enjoined therein carried out in a satisfactory manner—a matter of very great importance—and he will also be in a position to ensure in most cases that he gets the results which he desired. Such an Inspector very quickly obtains the confidence of the public, as the results he achieves are recognised as improvements not only by the property owners concerned but by their neighbours

Further, his services will be appreciated and his advice will even be sought, as few things are more difficult of satisfactory achievement in a tropical town than the renovation and remodelling of unsatisfactory permanent buildings.

RAT DESTRUCTION.

Kisumu.—100 traps were set daily, and in addition rat hunts were carried out from time to time in go-downs, in the Customs enclosure and in native villages with the results recorded below. Field rats were in most cases obtained by digging up their runs in and around native villages. They were not trapped nor were they found in huts except in exceptional instances.

	Rattus rattus kijabius.	Field rats.
January	97	689
February	95	413
March	151	19
April	57	729
May	77	337
June	84	585
July	65	422
August	16	597
September	31	913
October	232	—
November	304	—
December	198	—
Grand Total ...	1,407	4,704

Nairobi.—Poisoning with Barium carbonate was commenced on October 1st.

Number of Barium carbonate baits laid	39,566
,, ,, ,, ,, ,, taken	21,591
,, ,, dead rats found	243

i.e., one rat was found dead per 162 baits laid.

Trapping.

Month.	Males.	Females.
January	1,902	777
February	2,133	2,264
March	1,417	1,466
April	1,144	1,165
May	1,672	1,432
June	1,404	1,378
July	1,423	1,458
August	684	690
September	814	740
October	476	536
November	315	377
December	333	315
Total	13,717	12,598

Of the above all were black rats (*Rattus rattus kijabius*) with the exception of 1,588 field rats trapped in market gardens and other open places on the outskirts of the town.

Grand total for 1921	27,529
Grand total for 1920	7,859

Total number of rats found infected with plague during the year, 35.

Mombasa.—

Month.	Male.	Female.	Faetuses.
January	66	113	5
February	146	238	71
March	77	113	102
April	148	151	65
May	169	183	21
June	168	355	173
July	277	474	233
August	166	320	163
September	228	443	124
October	298	438	128
November	148	390	93
December	85	271	356
	1,976	3,489	1,534

Total rats trapped during year 1921	5,465
,, ,, ,, ,, ,, 1920	4,543

Of the above a considerable number were *Rattus rattus norvegicus*.

No infected rat was found during the year.

A small amount of poisoning with Barium carbonate was carried out.

ANTI-PLAGUE MEASURES IN FARMING AREAS.

All outbreaks that occurred were dealt with either by a Medical Officer or by an European Sanitary Inspector. Leaflets were also issued with regard to rat destruction, and a more detailed pamphlet is in course of preparation.

In all instances every assistance has been rendered by the occupier of the infected farm, and neighbouring farmers have willingly carried out rat campaigns on their premises. The occasional occurrence of rodent infection on farms in the neighbourhood of Native Reserves where the disease is enzootic cannot at present be prevented, but it is hoped that as a result of the propaganda which is being carried on, all European farmers and settlers will soon be sufficiently interested and expert in the matter of rat destruction and the prevention of rat infestation to reduce the number of such occurrences to a minimum and to prevent such as occur from resulting in the infection of man.

ANTI-PLAGUE MEASURES IN THE NATIVE RESERVES.

Inoculation.—As noted above and in the Annual Report for 1920, a Medical Officer was appointed in August of that year to the North Kavirondo district for the first time. That Officer found himself faced by a considerable and widespread epidemic of plague in a district with an area of 2,500 square miles and a population of over 300,000. Measures directed against the epizootic were not feasible at the time, and it was therefore decided to have recourse to the immunisation of the population on a large scale as being the only apparently practicable method of saving life, and over 20,000 inoculations were performed during the latter months of that year. As outbreaks were continuing to occur in 1921 a further 166,599 inoculations were performed during that year as shewn below.

Month.	Number.
January	28,399
February	48,842
March	14,048
April	14,218
May	1,996
June	10,689
July	18,542
August	17,282
September	5,137
October	3,355
November	4,003
December	88
Total	166,599

Partly these inoculations were performed at fords and bridges, partly by assembling at one time and place as many as possible of the population of any locations in which it seemed probable that plague might occur or recur, and partly they were carried out in areas where plague was present at the time. Between September, 1920, and September, 1921, almost two-thirds of the population were inoculated.

To estimate the effect of this inoculation is not easy. No figures are available as to the incidence of the disease among the inoculated and the uninoculated respectively, as the population was too illiterate and the staff available too small to allow of adequate records being kept in respect of this matter. The natives themselves, however, seem to have no doubt that the protection afforded was very considerate. The following facts must, however, be borne in mind :—

(*a*) Outbreaks had occurred in many locations before any large percentage of the population had been protected, and in many locations intensive inoculation was probably only carried out at a time when the epizootic in that particular area was already on the wane, and few further human cases would in any case have occurred. Under these circumstances any prophylactic would have gained a considerable reputation.

(*b*) In Central Kavirondo plague died out about the middle of the year without any large number of inoculations having been performed.

(*c*) In South Kavirondo the three outbreaks which occurred resulted in only a small number of deaths, in spite of the fact that no inoculations were performed until *after* the inhabitants of the infected area had had ample opportunity to acquire the disease.

(*d*) Experience elsewhere in the Colony has shewn that it is not impossible for a large mortality to occur among the rat population of a hut without any of the human inhabitants becoming infected.

(*e*) The period of the protection conferred by Haffkines' prophylactic is comparatively limited—probably not more than a few months.

(*f*) Most of the vaccine used must at one time or another have been exposed to very considerable temperatures between the time it left the laboratories in India and the time, months later, when it was used in Kavirondo.

It is possible, nevertheless, that many lives were saved, and in the circumstances, in face of possibilities which could not be estimated, in a district newly opened up as far as the Medical Department was concerned, and where no method of dealing with the rat appeared to be feasible, general inoculation of the population was undoubtedly a correct procedure.

It was at no time forgotten, however, that to combat the outbreak by protecting the population with a temporary immunity was not to deal radically with the infection, and it was realised from the beginning that no stone must be left unturned to devise some method by which the disease might, if possible, be eradicated from the district and its recurrence prevented.

If only on economic grounds this was urgently necessary as the purchase of vaccine alone was costing over £6,000 per annum.

RAT DESTRUCTION CAMPAIGN.

A campaign aimed at the destruction of rats on a large scale was, therefore, commenced in April, and was continued through the remainder of the year. This campaign has been unexpectedly successful, and as the results would appear to give some ground for hoping that the eradication of the plague from a large tract of country may perhaps not be impossible it may be useful to record in detail the manner of its inception and the methods employed in its execution.

The institution of a rat campaign on a large scale in British East Africa was first suggested by Professor W. J. Simpson, who in his Report on Sanitary Matters in East Africa, makes the following statement :—*

> " A similar campaign should be inaugurated against rats to the one recently waged with success in an infected district in Muanza, where, in 1913, 500 persons died of plague. Two Medical Officers, Drs. Manteuffel and Klein, visited the villages and informed the chiefs, elders and villagers that they intended to begin a destructive campaign against rats, and that they must help them. The proposal met with opposition at first on the part of the natives until the doctors explained to them that the rats were enemies to them, not only because they caused plague among them, but also destroyed their crops. The latter reason appealed to the villagers, and they promised to help the doctors and their staff.
>
> " One cent was to be paid for each rat delivered. The doctors set up their camps several miles distant from each other, and a trained boy and askari with cart visited the villages between. A certain number of the villagers were then deputed to do the work, which consisted in uprooting and burning the scrub around the hut, and in thoroughly beating the roof and sides of the hut with sticks inside and outside of the hut to drive out the rats and then kill them, and a ring of men outside to kill any rats that escaped. One cent was paid for every tail and feet of a rat brought in. The boy and askari had to return with the tails and feet every night as well as with a number of rats for examination. When this area was completed the doctors moved their camps to another district and proceeded on the same lines. In ten weeks 1,100,000 rats were destroyed. Out of these 10,000 rats were examined, and of these 4 per cent. were found infected. The rats were dipped in disinfectants immediately they were killed in the village.
>
> " A campaign of this kind should begin at the periphery, at the northern side of Yala, for instance, so that infected rats may not be driven into healthy areas."

That is to say it was suggested that an average of over 15,000 rats should be accounted for per day over a considerable period. It was not easy to see how that could be done. Previous experience of rat catching or of securing the destruction of rats by the offer of a reward had so far only been attempted in the towns and the results had been most discouraging. Of the prospects in the reserves nothing was known. The matter was, however, discussed with the District Commissioner of North Kavirondo, and early in April it was decided to make an experiment. A few days later, therefore, at the conclusion of a large meeting of natives in the location of South Kitosh, after a recital of the old and well-known story of the connection between rats and plague, and the destruction caused by the former to grain and crops it was suggested that the time had come when they should take some action in the matter. The District Commissioner then informed the meeting that he would return in four days, that in the interval every one should endeavour to catch as many rats as possible, and that on the fourth day they should meet him again in the same place, bringing with them all rats which they had destroyed. The proposal was received with a certain amount of amusement, and it was not easy to be sure whether it was appreciated that the suggestion had been put forward in all seriousness. One would not have been surprised if on the day arranged no rats had been produced. The result was, however, successful beyond expectation. On returning four days later men, women and children were found streaming into the meeting place from all directions. All were carrying rats. Some brought only a few, some brought baskets full. In all, 5,697 were counted, and when we left, more were still arriving. Thereafter the experiment was repeated in the other locations of the district, and at the same time an attempt was made to organise a campaign by instructing the chiefs to tell the people to bring in rats to the native courts which are held weekly on Mondays in each location. It was soon obvious, however, that such an arrangement would not be satisfactory for a number of reasons; firstly, no native likes carrying dead rats, secondly, they particularly objected to transporting for some distance on Mondays rats killed at any time during the previous week, thirdly, it was not possible entirely to rely on the enumeration, and lastly, it was soon obvious that if the matter was to be left solely to the chiefs, it was not likely to be prosecuted with vigour for any length of time.

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* African No. 1,025.

It was therefore ultimately decided to instruct the people through their chiefs that they should destroy rats on every opportunity, that they should cut off the tails and burn or bury the bodies, and that from time to time the bundles of tails were to be delivered to their chiefs. The chiefs were to send all bundles so collected to the District Commissioner at the end of each month, and they were told that an average number of five tails per hut per month should, if possible, be maintained. At the district headquarters the tails are in all cases counted, and the number verified by an European, usually the Medical Officer. If the number sent in by any chief is less than his location might reasonably be expected to yield he is informed to that effect, and told that his people must do better next month, and if possible, his location is visited towards the end of the next month by the Medical Officer to ensure that these instructions are being carried out. This, in brief, in the system now in vogue and it has proved entirely satisfactory in practice.

Certain details with regard to the execution of the campaign are, however, of considerable importance, and require elaboration.

It is to be noted that no rewards are given. Firstly, because it would have been impossible to have continued a system of rewards for any length of time if the results had been at all successful. At a cent a rat our results to date would have entailed the disbursement of over £2,000, as it is, no special expenditure has been incurred. The work has been done by the people themselves under the direction of the ordinary administrative and medical staff of the district. Secondly, if rewards had been offered, the campaign would have finished when the funds became exhausted. Thirdly, it was desired that the work should be done intelligently : that the people should destroy rats because it was a wise and useful thing to do, and not merely because the Government, for some reason which the native could not understand, was sufficiently foolish to be willing to pay for tails. It was desired, if possible, to make rat destruction a habit and part of the civilisation of the people.

To some extent this has been accomplished. In the old days little notice was taken of the rat, now if he is seen or heard he is hunted, and large numbers of tails are willingly sent in as a routine without either administrative or Medical Officers having to take much trouble in the matter, and there is reason to hope that there will be no difficulty in maintaining the campaign indefinitely.

It is to be noted that only tails are asked for, and that the people are told to burn or bury the carcase. This method of procedure has sometimes been deprecated in other countries as being dangerous because the carcases may neither be buried nor burned, but may merely be thrown into the nearest bush or long grass, where their fleas may leave them and attach themselves to other rodents or to man, and if they be infected so spread the disease. Possibly this may occasionally occur as it is very doubtful if many natives take the trouble either to bury or burn the carcases, but it is not easy to see how such a possibility can be avoided without making the execution of the campaign too laborious.

To enforce the carriage of the entire carcases to one central point where they could be buried or dipped in disinfectants would be to incur the much greater risk of carrying fleas from an infected area to an uninfected area since we are dealing with a large district, and it is not possible always to know the exact points at which rat plague exists. The problem is a large one and can only be attacked by an extensive and continuous campaign. No campaign will be continuous if it be made too laborious, and it is undoubtedly laborious to carry rat carcases every day to a depôt. One's object is to keep the population of domestic rats at a low figure over as large an area as possible, and if that be done it is of relatively little importance if a few infected fleas escape.

To have a large number of carcases brought to one place on one day is useful for purposes of advertisement at the commencement of a campaign, but it is not a method which can or should be maintained.

The last point of importance is that the reasons for the campaign must be made plain to the natives. To tell them once is not enough. The story of the rat and the flea and plague must be told again and again both by Medical and Administrative Officers whenever an opportunity presents itself, and the rôle of the rat in the destruction of stored grain should not be forgotten. This is constantly done in both the Kavirondo districts and in addition it is explained why for the present their energies are to be concentrated on the destruction of the domestic species only. If this be not done, a number of the lazier or less intelligent natives will take no action themselves, but will turn the matter over to the children. The latter will, as a rule, be unable to catch the elusive and well sheltered house rat and will concentrate their energies only on the field species whose destruction in considerable numbers is fairly easy. Whether as a result of such lectures or not the results so far have been very satisfactory, in this respect, an examination of the tails sent in showing that on an average over 90 per cent. of the rats destroyed have been of the domestic variety.

Differentiation of the dried tails of black rats from those of the field rats is not difficult, and whenever any undue preponderance of the latter is noticed in a catch the chief should be informed that his people are not giving sufficient attention to their huts.

The results of the North Kavirondo campaign which was started in April and of a similar campaign which was commenced in Central Kavirondo in

July are shewn in the accompanying tables, which have been completed up to the end of December. The totals are impressive, and in some cases surprising. It would not, however, appear possible by any statistical method to draw any conclusion as to the effect of this amount of destruction upon the rat population as a whole, too many factors are unknown.

What the average number of rats per hut may have been over the whole district at the commencement of the campaign in April is unknown, and consequently the average number left alive after the first month's killing is not known. Even if this were known, is would hardly help since the incidence of destruction in any district is always exceedingly uneven. Certain villages of a district may kill all, or nearly all their rats in one month, while others kill comparatively few. During the next month the villages hither inactive may become active, while those which were energetic in the previous month may do little or nothing. It is too soon yet to say whether in any large number of villages the rats are now never left in peace long enough to be able to maintain their strength or to increase in numbers. So far it is only possible to note the following points :—

(1) The figures given in the tables have in all instances been verified by tail counting carried out by an European.

(2) The figures given are less than the total numbers actually killed. A considerable number of tails are forgotten or lost, never reach headquarters and are consequently not recorded.

(3) A large number of litters being left unprotected probably perish.

(4) *A majority, probably over* 90 *per cent., of the rats destroyed are house rats.*

(5) Of the house rats those of Central Kavirondo are in all cases the " black " rat, *Rattus rattus kijabius*; those of North Kavirondo are as far as most of the district is concerned also " black " rats, from a small area of North Kavirondo, however, where the black rat does not exist, they belong to one of the " multimammate " species.

(6) It was suggested that each chief should be able to send in monthly a number of tails which would give an average of at least 5 rats per hut per month for his location. Some figure had to be given as a minimum standard and five was chosen, as it had been ascertained by experiment in several different areas that this number could, as a rule, be obtained. It has since been found by experiment (*vide* report *re* Kabete, page 62, that as many as 15 per hut could be obtained over an area of a square mile in a certain district, and it has also since been demonstrated in a certain area in South Kavirondo that under certain circumstances an average of 5 per hut could not be obtained.

It is possible that the degree of infestation varied considerably in different parts of North and Central Kavirondo from time to time. The tables show that in Central Kavirondo the standard figure of 5 was attained or exceeded in three locations out of 17 in July, in none in August, in one in September, in one in October, in none in November, in one in December, and that in only two locations was it attained or exceeded in two months out of six, the largest average figure for any location for one month was 8·2. In seven locations out of 17 an average of over 10 rats per hut per six months was attained, and in one location the figure was as large as 23. The average number of rats per hut per six months was 9.

In North Kavirondo the results of nine months' work is as follows :—

The standard figure of five was attained or exceeded in one location out of 19 locations in July, in one in August, in none in September, in two in October, in three in November, in five in December; in only two

RAT DESTRUCTION RETURN :—KISUMU AND CENTRAL KAVIRONDO DISTRICTS, 1921.

Location.	Chief.	Huts.	July.		August.		September.		October.		November.		December.		Totals.	
			No of Rats.	No. per Hut.	No. of Rats.	No. per Hut.	No. of Rats.	No. per Hut.	No. of Rats.	No. per Hut.	No. of Rats.	No. per Hut.	No. of Rats.	No. per Hut.	No. of Rats.	No. per Hut.
Alego ...	Ngonga ...	13,169	11,901	·9	—	—	19,865	1·5	17,600	1·3	7,000	·5	42,939	3·3	99,305	7·5
Asembo ...	Odindo ...	5,465	14,744	2·7	6,964	1·3	9,330	1·7	9,073	1·1	10,884	2·0	18,800	3·5	59,795	10·9
N. Gem ...	Ogada ...	10,162	17,129	1·6	—	—	52,024	5·1	25,347	2·5	20,060	2·0	61,790	6·1	176,350	17·4
S. Gem ...	Ndeda ...	6,164	24,899	4·0	3,296	·5	10,335	1·7	7,630	1·2	9,715	1·6	15,010	2·4	70,885	11·5
Kadimu ...	Okello ...	2,259	2,940	1·3	3,787	1·7	6,366	2·8	—	—	8,366	3·7	6,950	3·1	28,409	12·6
Kajulu ...	Owuor ...	2,638	1,490	·5	1,615	·6	6,193	2·4	540	·2	10,848	4·1	4,515	1·7	25,201	9·6
Kano ...	Amimo ...	14,880	4,240	·3	3,840	·3	1,365	·1	15,580	1·0	23,163	1·6	14,900	1·0	63,088	4·2
Kisumu ...	Obiero ...	5,578	6,380	1·1	—	—	7,682	1·4	940	·2	4,060	·7	3,290	·5	22,352	4·0
Nyakach ...	Kere ...	7,741	—	—	460	·1	7,056	·9	4,749	·6	1,730	·2	3,300	·4	17,295	2·2
Nyangori ...	Sonono ...	2,270	1,093	·4	—	—	1,190	·5	590	·2	5,050	2·2	4,383	1·9	12,306	5·4
Sagam ...	Orawa ...	1,873	9,740	5·2	1,680	·8	7,696	4·1	1,990	1·1	3,349	1·7	1,290	·7	25,745	13·7
Sakwa ...	Olulu ...	4,635	8,975	1·9	863	·2	7,105	1·5	480	·1	1,981	·4	1,550	·3	20,954	4·5
Samia ...	Kadima ...	8,992	52,000	5·8	20,312	2·2	39,902	4·4	—	—	9,780	1·1	29,174	3·2	151,168	16·8
Seme ...	Oguk ...	10,148	8,227	·8	9,810	·9	3,417	·3	5,646	·6	14,780	1·4	5,533	·5	47,413	4·7
N. Ugenya ...	Muganda...	7,460	18,374	2·5	—	—	13,164	1·8	10,832	1·4	6,180	·8	13,935	1·9	62,485	8·4
S. Ugenya ...	Mugenya...	1,913	9,713	5·1	7,600	4·0	1,426	·8	15,632	8·2	3,090	1·6	7,466	3·9	44,927	23·5
Uyoma ...	Mogi ...	4,181	2,560	·6	6,730	1·6	10,170	2·4	14,321	3·4	10,718	2·6	1,130	·3	45,629	10·9
Totals ...	—	109,528	194,405	1·8	66,957	0·6	204,286	1·9	130,950	1·2	150,754	1·4	236,035	2·2	983,387	9·0
Settled Areas	—	—	535	—	3,446	—	4,068	—	484	—	43	—	57	—	8,633	—
TOTALS ...	—	109,528	194,940	—	70,403	—	208,354	—	131,434	—	150,797	—	236,092	—	992,020	—

RAT DESTRUCTION RETURN:—NORTH KAVIRONDO DISTRICT, 1921.

Location.	Chief.	Huts.	April to June.		July.		August.		September.		October.		November.		December.		Total.	
			No. of Rats.	No. per Hut.	No. of Rats.	No. per Hut.	No. of Rats.	No. per Hut.	No. of Rats	No. per Hut.	No. of Rats.	No. per Hut.	No. of Rats.	No. per Hut.	No of Rats.	No. per Hut.	No. of Rats.	No per Hut.
Wanga ...	Mumia ...	7,749	95,429	—	—	—	9,069	1·1	4,230	·5	6,338	0·81	11,198	1·4	5,944	0·7	36,779	4·7
Marama ...	Malama...	8,694		—	—	—	27,363	3·1	—	—	10,923	1·25	30,558	3·5	64,313	7·6	133,157	15·3
E. Kakamega	Osere ...	2,830		—	5,180	1·8	3,064	1·0	—	—	7,237	2·55	10,094	3·5	14,935	5·2	40,510	14·3
Watsotose ...	Wambani	1,711		—	—	—	—	—	537	·09	72	—	6,751	3·9	15,229	8·9	22,589	13·2
W. Kakamega	Mulimo ...	5,432		—	2	—	1,388	·2	339	·06	7,043	1·29	23,998	4·4	26,418	4·6	59,188	10·9
Mukulu ...	Repande	1,643		—	—	—	—	—	—	—	3,295	2·00	2,060	1·4	7,806	4·7	13,161	8·01
Kakalewa ...	Ndombi...	1,782		—	—	—	—	—	426	·2	1,429	0·8	6,529	3·6	7,499	4·2	15,883	8·9
Kabaras ...	Mwanza...	3,037		—	—	—	—	—	—	—	18,923	6·23	5,130	1·6	5,775	1·9	29,828	9·8
N. Kitosh ...	Marunga	8,505		—	—	—	—	—	—	—	6,942	0·8	40,769	4·7	25,718	3·02	73,429	8·6
S. Kitosh ...	Sudi ...	7,017		—	—	—	—	—	—	—	39,804	5·6	46,139	6·5	16,838	2·3	102,781	14·6
Wamia ...	Kadakada	6,261		—	26,500	4·2	—	—	—	—	5,929	0·9	36,796	5·5	4,300	0·6	73,525	11·7
Marach ...	Oduya ...	5,107		—	—	—	—	—	—	—	5,286	1·1	12,662	2·7	12,780	2·7	30,728	6·01
Ohaye ...	Okwara	4,447		—	35,811	8	—	—	—	—	11,154	2·5	24,669	5·5	9,719	2·1	81,353	18·3
Kisa	Kuta ...	1,725		—	4,300	2·4	6,175	3·5	996	·5	—	—	6,225	3·6	5,440	3·1	23,136	13·4
Tiriki ...	Amian ...	4,986		—	3,300	·6	225	0·4	1	—	2,557	0·5	23,642	4·7	28,028	5·6	57,753	11·7
S. Maragoli ...	M'nubi ...	6,853		—	11,500	1·6	36,858	5·3	—	—	—	—	22,278	3·7	36,246	5·5	106,882	15·4
N. Maragoli ...	Shwachi	9,232		—	4,500	·4	6,175	—	—	—	19,645	2·1	13,601	1·4	34,400	3·6	78,321	8·4
Bunyere ...	Songoro...	9,484		—	5,600	·5	5,993	·6	—	—	691	0·07	32,108	3·3	47,019	4·9	91,411	9·6
Waholo ...	Were ...	2,470		—	—	—	—	—	23	—	4,922	1·9	3,400	1·3	6,945	2·8	15,290	6·1
—	—	—		—	—	—	—	—	—	—	—	—	—	—	—	—	95,429	·9
Total ...	—	98,965	95,429	—	96,693	—	96,310	—	6,552	—	152,190	—	358,607	—	375,352	—	1,181,133	11·9

locations was it attained or exceeded in two months out of six; the largest average figure for any location for one month was 8·9; in 10 locations out of 19 an average over 10 rats per hut per six months was attained, and in one of these the figure was 18·3; the average number of rats per hut per nine months was 11.

(7) It must also be noted that the total for any location or for any month bears a relation to the amount of attention the Medical Officers were able to devote to this work during the month, *e.g.*, particular attention was devoted to Samia in July, and to the whole of North Kavirondo in November and December. Very little attention has yet been given to Nyakatch. The personality of the chief is also of considerable importance. It does not necessarily follow from the fact that in North Kavirondo a larger number of rats was killed in November than in any previous month, and that this number was exceeded in December, that the destruction of previous months had been of no effect.

Actually the increase in the numbers killed in November and December was very largely the result of a special effort on the part of the Medical Officers; it may also have been due in part at least to the people having become much more skilled in catching rats. It is also possible that a comparatively larger number of rats were available in these months owing to a natural *seasonal* increase at that time. With regard to a special breeding season, however, we have as yet no information.

It is also quite possible that if the destruction of previous months had not taken place the special efforts made in November and December would, considering the improvement in technique on the part of the natives and the improvement in the organisation which had been achieved by the Medical Officers most probably, have resulted in many more rats being killed than was actually the case.

(8) The number of rats destroyed per head of the human population over the period of six months in Central Kavirondo is three, and over the period of nine months for North Kavirondo is 3·9, while the average number killed per day over a period of six months for the whole area was 11,291.

(9) The results so far achieved suggest that a system of rewards is unnecessary at least in Kavirondo.

Effects of the Rat Campaign on the Incidence of Plague.

In the absence of detailed records of past outbreaks of plague in these districts, and particularly in the absence of information with regard to their seasonal incidence, it is not yet possible to draw any conclusions as to the results of the campaign, and it is unlikely that it will be possible to do so until it has been in operation for some years.

Circumstances Facilitating the Campaign.

(1) Not the least important factor is the intelligence and energy of the natives of the Kavirondo districts and the willingness with which they will accept advice and adopt new methods.

(2) The campaign had the hearty support of the Administrative Officers of the districts, without whose assistance and ready co-operation success would have been impossible.

(3) Lastly, it is to be noted that in these Native Reserves the execution of sanitary work has not been divorced from the practice of curative medicine. African natives are rather shy people, and they will not readily work or

co-operate with officers whom they do not know. It is essential that they should be "handled." It is not always easy, particularly for a stranger, to demonstrate to them that new methods are desirable or an improvement on old ones. If, however, innovations are suggested to them by a man whom they know, whom they are meeting frequently, who at the same time is obviously doing something for them, which they can appreciate and recognise as useful, say, in the way of curing ulcers or treating yaws and skin diseases or coughs and colds, and advising them with regard to the treatment of injuries, there is much more chance that advice will also be accepted with regard to other matters, and that ready and willing co-operation will be obtained.

It is very unlikely that the rat campaign could have been maintained by Medical Officers engaged on purely sanitary work and visiting the people only at infrequent intervals. That it has been maintained, and that very satisfactory results have been obtained without rewards and without the exercise of undue pressure has very largely been due to the fact that it was carried out by Medical Officers stationed in the districts, who were in constant touch with the natives of each location through the small out-dispensaries which have been established in most of these locations, who were constantly on tour in their districts and were at the same time as they preached sanitation, treating patients and curing disease.

Rat Campaign in the Kikuyu Country (Kiambu Native Reserve) near Nairobi.

In August it was decided to endeavour to institute in the Kikuyu country a rat destruction campaign similar to that which was being carried on in the Nyanza Province, and on the 22nd of that month a large meeting of chiefs and head-men was held at Dagoretti. The relation between rats and plague was carefully explained and photographs of the results obtained by the Kavirondo were shown to the people. No great enthusiasm was evidenced, but it was arranged nevertheless that a campaign should be commenced, and that we should return a week later to see the results. The result was six rats. The people said they could not catch rats without traps. We, therefore, adjourned to the nearest native hut, and by removing the stores of firewood and the grass bed from within the hut and by beating the roof were able in a short time to destroy thirty-one. This demonstration having been given, the natives were enjoined to make another attempt to kill rats, with the results that during the following week over 2,000 were produced, and during the week after 2,000 more. These results were, however, very meagre compared to the catches which were being obtained in Kavirondo and no great interest could be aroused. With the object of stimulating some interest and in order to demonstrate to the people that the greatest importance was attached to this matter by the Government, His Excellency the Acting Governor kindly consented to come to Dagoretti to see one of the weekly catches. For his inspection it was only possible, however, to raise a few over 6,000 rats. Thereafter the weekly catches gradually diminished and the campaign was ultimately suspended. The results in other parts of the Kikuyu country were equally disappointing.

The reasons for the failure of this campaign are several. Firstly, the people themselves are of a very different constitution from the Kavirondo. They are much more attached to old ways and customs and slow to adopt new ones. Secondly, the attempt to institute the campaign was made by Medical Officers from Nairobi whom the people did not know. Thirdly, the people were not particularly interested in the prevention of plague as that disease does not occur among them in an epidemic fashion. Lastly, it would appear that these people have not yet discovered for themselves the association between human deaths from plague and an antecedent rat mortality. That story they were now hearing for the first time, and it is probable that but few natives other than those whose villages had been attacked by the disease believed it. The work done has not, however, been wasted. They have now heard the story and when next it comes to be told it will not come entirely as a new thing. If, in the interval, any cases of plague should occur their association with an antecedent rat mortality will probably be noticed, it will be remembered that they were told that this would happen if they did not first kill the rats themselves and the chances in favour of the successful prosecution of a campaign will be increased.

Of the reasons which are given above for the failure of the campaign the second is almost certainly the most important. If this people had for some time before its institution been " handled by the Medical Department, if small out dispensaries had been established in each location, and if the campaign had been instituted and carried out by a Medical Officer whom they knew and whom they recognised as one who was working with them and for them, instead of being carried out as it was by an unknown Medical Officer from Nairobi, there is little doubt but that it would ultimately have met with a very fair measure of success. The Kikuyu are by no means unintelligent, but they are suspicious and conservative, and till the Department is in a position to undertake curative medicine in this part of their country there is but little likelihood that any notable measure of sanitary progress will be obtained.

It is hoped that will be possible to post a Medical Officer to this district during 1922.

5.—NOTE ON THE OBSERVATIONS MADE DURING THE EXECUTION OF ANTI-PLAGUE MEASURES.

On the 17th of August three cases of plague and four deaths from the same cause were reported to the Medical Department by a Kikuyu headman as having occurred in the Native Reserve near Kabete about 10 miles from Nairobi. On investigation the report was found to be correct, and it was also found that the headman—a particularly intelligent native—had caused the three huts which were involved to be evacuated by the survivors. Instructions were given to the headman that these three huts were to be deroofed, that any rats found during the process were to be killed, that the huts were to be left vacant for ten days, and that thereafter they were to be replastered before being reoccupied. Inoculation was offered to the folk of the immediate neighbourhood, and was taken advantage of by about 300 natives.

A native dresser was left at the village, and arrangements were made for the treatment of the sick in a new hut which was nearing completion but had not yet been occupied. About 15 Barium carbonate baits were also laid in each hut in the neighbourhood over an area about half a mile square. When the place was visited two days later it was found that the instructions, which had been given with regard to the deroofing of the infected huts, had been satisfactorily carried out. The headman was further instructed to endeavour to get his people to kill as many rats as possible, and a few days later, as a result of his efforts, some six hundred rats were produced. These rats had been killed chiefly by hunting in the roofs of the grain stores. No action was taken with regard to the deroofing of any huts other than the three actually known to be infected, firstly, because the villages affected were comparatively isolated and secondly, because it was feared that such action might result in future concealment on the part of the Kikuyu. That this outbreak had been reported at all had been in fact a matter of considerable satisfaction, as the Kikuyu native is, as a rule, very reticent with regard to such occurrences.

It was stated at the time by the headman that previous to this outbreak a dead rat had been imported into the area from a boma where the rats had been dying some two miles away in the hope that the rats in the area now infected might die also. If the story was true, which there it little doubt it was, the experiment had been more than successful.

No further cases occurred in the immediate neighbourhood of these huts, but on the 8th of September, 11 cases were reported by the same headman as having occurred in some huts about a mile distant. On visiting the area on the same day, there were found five cases of plague and six freshly filled in graves.

As the action taken with regard to the previous outbreak had not resulted in the concealment of this one, and as the headman was particularly intelligent, and had carried out a good deal of propaganda with regard to the connection between rats and plague in the interval, it was decided to adopt more radical measures than were taken with regard to the previous outbreak.

The people were now obviously afraid of the disease and apparently willing that something should be done. As it was suspected that the huts were badly infested with rats, and it appeared probable that many more cases might occur, the area being a somewhat populous one, it was therefore decided to make an attempt to " sterilize " the area with the object both of preventing further human cases within the area and of preventing any spread of the epizootic to other parts of the district. A Medical Officer who had had considerable experience in deratting operations in another part of the country was put in charge and remained on the spot for about ten days. His report with regard to the action taken is as follows :—

" On the 8th September, 1921, on report of plague in this district being sent in to the P.M.O.'s Office, I accompanied the Chief Sanitation Officer on a visit of investigation. Five cases of bubonic plague and a few freshly filled in graves were seen. These were spread over a very small area which consisted of two hills separated by a narrow gulley.

" It was decided that efforts should be made immediately to attempt to stop the outbreak and prevent the spread of the disease by a thorough deratting campaign in the area infected and the district around.

" On the morning of the 9th, I returned to this area with six bush tents placed at my disposal by the Chief Sanitation Officer.

" The tents were pitched on the slope of a hill about 200 yards away from the infected areas, and all cases found were removed here. At the same time all the inhabitants of the infected huts were advised to take up their residence in the camp and accommodation was allotted them—they were told they could return to their huts a week after they were thoroughly deratted and cleaned out. In every case this advice was followed.

" The following cases were admitted to the camp :—

" 1. Gathuya s/o Kibui, bubo in groin. This case died shortly after admission.

" 2. Kamau s/o Jeroge, bubo in neck. Case was doing well when I left on the 17th.

" 3. Mwara s/o Jeroge, bubo in neck. Case was doing well when I left on the 17th.

" 4. Gere s/o Jeroge, bubo in neck. Case was doing well when I left on the 17th.

" 5. Guponde s/o Hesekiya, bubo in neck. Patient died on 11-9-21.

" 6. Thuo s/o Hesekiya, bubo in neck. Died 11-9-21.

" A native medical orderly Kamau was put in charge of the camp and attended to the sick as required.

" *Deaths.*—Six deaths were reported to have occurred in this outbreak previous to my arrival—so that in all there were only nine deaths. A further three deaths were reported, but I have not counted these in as I was not satisfied that plague was the cause of death.

"*Previous History.*—A small outbreak of plague had occurred in some huts in the area, about one mile away from the area of present outbreak about six weeks previous—this had been dealt with by the Chief Sanitation Officer.

" The earliest case of plague in the area that could be proved was one some two months ago—on the hill beyond the present affected area—here there had evidently been plague and few deaths, but the natives had not quite understood what the disease was. There were quite a number of dead rats found in this area.

" *Anti-Plague Inoculations.*—There was no compulsory inoculation, but all natives who expressed a wish to be done were inoculated—in all 650 natives were done— this number included women and children.

" *Description of Kikuyu village and hut.*—The native villages in this district are small—the largest consisting of some six or seven huts, each hut has two to three grain stores belonging to it. The whole village is surrounded by a thorn fence, making what is virtually a little boma.

" The huts are usually of the ordinary native pattern. The circular wall in the best huts is built of solid timber, the crevices being filled in with a mixture of mud and dung. The walls or sides of the meaner huts are built of twigs interlaced—the inner surface of this being daubed with a mixture of mud and dung.

" The hut is covered over with thatch, which is made as follows :—

> " First a layer of banana leaves is placed over the frame work. This is covered over with bracken about 6 inches thick. This is then covered with grass or straw. The whole forming a very thick and dense thatch.
>
> " The beds are made by the partitioning of a portion of the hut with stakes and filling this partition with bracken and twigs. When first laid down the bed is only about a foot in height, but as time goes on constant addition increases the bulk and height.
>
> " The little pen for goats and sheep inside the hut has its floor raised off the ground when first put in. But as time goes on the litter and garbage below it increases, and it is only after scraping, etc., that one can appreciate that it was once a raised structure.

" *Firewood.*—Huts contain varying quantities of this commodity. Some huts being nearly full of it, stacked in piles wherever there is any space. Other huts contain only a small quantity.

" *Deratting Campaign.*—The deratting campaign was started on the afternoon of the 9th. The infected villages being done first.

" All through the campaign I was ably assisted by the headman of the district, Josiah, and a number of mission boys.

" Josiah had issued orders that all men and boys in his district should turn out and help. At first the turn out was small, but as the campaign proceeded the natives entered into the spirit of it and turned out in numbers, so that we were able to have at least three parties working simultaneously.

" In deratting the huts we first removed the roofs—leaving a ring of boys round to kill any rats that tried to get away. No rats were found to leave the hut during the removal of the grass, while in removing the bracken and banana leaves, though rats were seen they all jumped inside the hut and took shelter in the bed.

" This being so after the first day we gave orders for huts to be prepared for us from day to day by the women, by being deroofed as far as the bracken layer. This besides easing our work considerably, was very popular with the natives as they were then able to remove the grass carefully and put it aside for replacing.

" When the roof had been carefully removed, the work of emptying the huts was proceeded with. About four to six boys with sticks were sent into the hut to do this work, while the women who lived in the hut assisted. The remainder of the gang with sticks, about ten in number, maintained the ring round the hut.

" First, all firewood had to be taken out and removed to a distance. In doing this some few rats were sometimes found and killed.

" Next, the bed was brought out bit by bit. To get at this it was always found advisable to first remove the stakes enclosing it. As a rule the cleaning out of the bed was a woman's job. It was in the bed that we found most of our rats—a few, however, had to be gone after in the loose earth below the bed, the rats evidently find it very easy to burrow here, and in some huts it was necessary to dig quite a considerable bit of the floor out before being satisfied that the hut was completely deratted.

" Practically no rats get away, for as soon as they show themselves they are killed by the boys inside, or if they manage to break out of the hut are put an end to by the ring outside.

" All through the deratting a clear space is kept all round the hut so that rats in coming out have no cover.

" After the bed, the goat pen is tackled, most of the wood work is removed, and then the floor dug up. All efforts are made to prevent any likely place for a rat to harbour being left unexposed. It is in the bed and the loose earth beneath it that rat nests are found and the litters destroyed.

" Lastly, before a hut of the meaner sort is declared completely rat free, when the boys working inside declare their work done, the ring outside poke their stocks into the side of the hut to drive out any rats that might have found a hiding place in any loose bit of the wall.

" If this routine is carried out rigorously and thoroughly, I am of opinion that no rat remains in a hut.

" The numbers of rats killed in various villages varied considerably. The same can be said for the huts in any one village.

" As a rule the hut occupied by the headman of any village was comparatively free. This hut often had no bed and no stacks of firewood, and is evidently cleaned out by the women daily.

" New huts were fairly free—while the older the hut, the more filthy it was, and the more infested with rats.

" In the huts where plague had occurred during this outbreak very few live rats were found. Numbers of dead ones being turned out of the bed. In some huts as many as 12.

" In the huts where plague had occurred six weeks to two months ago, numerous dead rats were found. These were merely skeletons. Here fresh families of rats had already come in and quite a few rats were killed. Practically in every one of these huts nests were found with litters of young rats. The young in these huts exceeded the grown up rats, being about 60 per cent. of the total. This was quite different from the other huts in which rats were plentiful, for here the young rats only constituted about 10 per cent. of the total.

" In all an area of about one square mile was deratted.

"Total number of huts deratted	180
" Total number of rats killed	2,750
" Average number per hut	15
" Maximum number in one hut	63
" Largest litter found	10

" In the area in which plague had occurred, 11 huts produced 64 dead rats, while only 33 were killed. Of these 11 were young taken from the nests.

" The best average got from any village was 98—a village of two huts.

" A few of the grain stores were deratted carefully for rats at the start of the campaign, but with no success. Josiah explained that he had all the bins deratted carefully for the first rat campaign he had in his district some weeks before, when about 600 rats were killed.

" At the end of the campaign, the 17th September, the headman Josiah was advised to give his men a rest for a few days and then proceed with the rat killing in his district. This he has promised to do, and I am of opinion that it is more than likely that his promise will be fulfilled."

No further cases of plague were reported in this area until the 20th when two cases occurred. On investigation it was found that these cases had occurred in two huts towards the periphery of the area which had been deratted. These huts had been deroofed, and very old dead rats had been found in the beds in both instances; the owners said they had been advised to vacate these particular huts for a week, but had not done so as they had not thought it worth while; they also said they now realised that the advice had been sound.

Up to the time of writing (March, 1922) no further cases have been reported either from the above area or from the neighbourhood, and as no attempt had been made to conceal the two last mentioned cases, and as the headman is reliable and takes a great interest in his location, it is highly probable that none have occurred.

The rats found during the above operations were in all cases the black rat (*Rattus rattus kijabius*). It has previously been noted that this rat is not by preference an earth burrowing animal, and that for nesting purposes it always takes advantage of existing open spaces. In the Kavirondo district, where the floors of the huts are beaten hard, and where the natives do not use grass beds, but sleep on a skin on the floor, the black rat lives and nests in the roof. In the Kikuyu country of the Kiambu district, however, an even more ideal shelter than the thatch of the roof is offered by the extraordinary collection of grass and bracken which is used as a bed in almost every hut, and in these huts nests are almost invariably found not in roofs but in the beds of the people themselves, or occasionally in the loose earth under the goat pen. That is to say, the rat is here apparently living in the very closest possible association with the human population. It is somewhat remarkable, therefore, that while rodent plague would appear to be as common in the Kikuyu country as in Kavirondo, human cases are of much less frequent occurrence, while such cases as have been recorded have occurred only in small groups or in a very sporadic fashion. That they may even be said to occur sporadically within the hut is evidenced by the following occurrence.

A death from plague was notified as having taken place in a hut about seven miles from Nairobi. Some cases of the disease had occurred in a village about two miles distant from this hut about ten days previously, but in the immediate neighbourhood there had been none. On investigation it was found that the death had occurred the previous day, and that there were still two persons living in the hut—a mother and child. The mother stated that ten days previously two other children of hers had died, and that shortly before these deaths the rats had disappeared.

On removing the thatch of the hut no rats were found in the roof, but one live rat and ten dead ones were found in one of the two grass beds which the hut contained. These beds were ineffectively separated from each other by a log partition. The rats found appeared to have been dead about ten days as stated by the mother. The three children, who had died, had slept in the bed where the rats were found, while the mother and the surviving child had occupied the bed which was not infested. That is to say one child apparently continued to occupy a bed where ten rats had died of plague for at least a week before herself becoming infected—it is unlikely that the incubation period was in this instance longer by ten days than in the cases of the first two children—while two persons had continued to occupy a contiguous bed during the same period without becoming infected at all.

As instancing the sporadic fashion in which cases of plague occur, not only in the villages or bomas, but over the country side, the following summary of the results of an investigation of the conditions in another infected area in the Kikuyu country may be quoted.

The investigation was carried out by a European Sanitary Inspector who was camped in the area for some weeks.

Size of area involved about six square miles.

Population of area	about 700
Number of huts in area	,, 250
Number of cases of plague	16
Number of bomas infected	12
Total number of huts in infected bomas	37
,, ,, ,, inhabitants of infected bomas	86
,, ,, ,, huts in which cases occurred	14
,, ,, ,, inhabitants in infected huts	43
,, ,, ,, huts in which more than one case occurred	2

Infected Bomas.	No. of Huts.	No. of inhabitants.	No. of huts infected.	No. of inhabitants of infected huts.	No. of cases.	Date of cases.	Distance of boma from nearest infected boma.
Boma No. 1	10	23	1	2	2	4-12-21 5-12-21	600 yds.
,, ,, 2	2	7	1	3	1	12-12-21	30 ,,
,, ,, 3	2	5	2	5	2	7-12-21 14-12-21	30 ,,
,, ,, 4	4	9	1	4	1	5-12-21	1,000 ,,
,, ,, 5	1	6	1	6	1	12-12-21	1,500 ,,
,, ,, 6	2	6	1	3	1	14-12-21	1,000 ,,
,, ,, 7	1	3	1	3	1	27-11-21	225 ,,
,, ,, 8	2	8	1	3	1	12-12-21	700 ,,
,, ,, 9	3	6	1	2	1	?-12-21	225 ,,
,, ,, 10	4	?	1	3	1	27-11-21	75 ,,
,, ,, 11	3	8	1	4	2	?-11-21 7-12-21	500 ,,
,, ,, 12	3	5	2	5	2	14-12-21 16-12-21	2,500 ,,
	37	86	14	43	16	27th Nov. to 16th Dec.	

Of the above cases, seven occurred in adults and nine among children. In almost all the bomas a history of an antecedent rat mortality was obtained. The location in which the above bomas were situated lay about thirty miles from Nairobi, and the native population was unsophisticated to a degree. They held strong prejudices against the removal of the roofs of huts or any interference with the contents and particularly against interference with the grass beds. As it has not yet been possible to establish among these people small out dispensaries of the type which have been so successful in Kavirondo, the Medical Department is as yet practically unknown to them, and their confidence has still to be obtained. It was not therefore possible to take any radical steps with a view to eradicating the infection and but little more could be done than to offer the people the protection provided by inoculation, to treat the sick and to explain to the population generally the connection between rats and plague in the hope that sufficient confidence might be established to allow of more radical measures being adopted on a future occasion. Barium carbonate baits were prepared, and an attempt was made to get the people to lay these in their huts without much success, as the people in this area, contrary to experience in most other parts of the country, evinced a considerable amount of prejudice against the proceeding. Haffkines' prophylactic, on the other hand, appeared to be popular, and over 1,000 natives from the infected area and from the surrounding district presented themselves for inoculation.

The last case occurred on the 16th of December, and up to the date of writing (March 1922) no further cases have occurred. It would, however, seem unwise to attribute the cessation of cases entirely to the immunisation of the population as more than half the cases had occurred from a fortnight to a week before the outbreak was reported and inoculation became available, while many people had continued to live for that period in the infected huts without acquiring the disease.

The above accounts are typical of all outbreaks of plague that have occurred in the Kikuyu country, *i.e.*, very large numbers of rats will die in a hut or in all the huts of a boma while but one or two human cases result.

Similar occurrences have also been recorded both in the North and Central Kavirondo districts and in South Kavirondo, though in the North and Central districts considerable numbers of deaths in one boma have, from time to time, been recorded. It has been noted above that in and around Kakamega station in North Kavirondo, Xenopsylla cheopis is a not infrequent parasite of the black rat, while in the Kikuyu Reserve practically the only flea found is brasiliensis. Should further observations show that the observations made at Kakamega hold for the whole of the North and Central Kavirondo country, this fact might in part explain the greater incidence of the disease in those districts as against the very sporadic fashion in which it appears in the Kikuyu country. Should it not, however, be found that a fair proportion of the rat fleas over the whole of North and Central Kavirondo are cheopis, some other explanation will be required to account for the fact that in the Kikuyu country where the association between rat and man is apparently very much closer than in Kavirondo the chances of the infection being transferred to man would seem to be much less.

As has already been noted such an explanation might possibly be afforded by the custom which pertains among the Kikuyu of anointing the whole body with a mixture of red earth or clay and castor oil. The custom of anointing the body is not, of course, unknown among the Kavirondo, but as the oil is not mixed with earth less oil is retained on the surface of the skin. Further the oil used by the Kavirondo is a kind of ghee, and the use of castor oil for this purpose is unknown.

A less likely but not altogether improbable explanation might be that a very considerable degree of protection may be afforded to the people by the actual structure of the grass beds. It may be that the very thickness and density of these great collections of grass and twigs and bracken effectually prevents the fleas from rats *dead* of plague ever finding their way to the surface save in a few exceptional instances.

REPORT ON A SHORT, SMALL MAMMAL SURVEY AND THE DISTRIBUTION OF *RATTUS RATTUS KIJABIUS* IN THE NORTH KAVIRONDO DISTRICT.

On the invitation of the Medical Department, Kenya Colony, I undertook to make a six months' survey of the small mammals in North Kavirondo district, Nyanza Province, and to try, if possible, to work out exactly the distribution of *Rattus rattus kijabius.* This rodent is the rat commonly found in native houses in the southern locations of the district, and had been proved to be the carrier of plague, and furthermore, the *Rattus rattus kijabius* was reported to have but comparatively recently invaded the district and to be driving out another rat called by the native " Muunchu," which formerly was the animal usually found in huts.

I arrived at Kakamega on June 6th and met the Medical Officer, Dr. Nunan. We discussed at some length the best method of procedure for making the survey, and decided that with the short time at my disposal the work could be thoroughly done only by taking location by location, and headman by headman, starting from Kakamega itself.

Kakamega Boma.—I stayed here till June 26th, trapping and examining rats brought in by natives. All the rats caught in houses proved to be *Rattus rattus kijabius*; the common field rat, *Arvicanthis sp.* (?) was abundant and a number were trapped and preserved as specimens. Of the other animals collected nothing can be reported till the collection is worked out.

The proportion of males to females of the *Rattus rattus kijabius* examined, worked out at almost 1 to 2.

It was during my stay here that I noticed that fleas on plague infected rats appeared to be very sluggish in their movements.

From Kakamega I safaried to Wanga, Ohayo and Southern Wamia (Kada-Kada's camp), camping for a few days at each place.

Here again all the house rats were found to be *Rattus rattus kijabius,* and the natives reported that this animal had been established in their countries for some years; there was history of plague and actual small outbreaks of plague during my safari.

I examined several villages from which plague and dead rats had been reported, and found very few living rats, and from two native bomas in which I found dead rats (subsequently proved to be plague infected) I obtained no living specimens at all.

The proportion of males to females of all the *Rattus rattus kijabius* examined again worked out at about 1 to 2.

During my examination of native villages, remains of the common field rat, *Arvicanthis sp.* (?) were occasionally found in the grass roofs of houses and corn-bins, but as the remains were old, no spleen smears could be taken for investigation.

On July 26th I marched from Kada-Kada's camp, South Wamia, to Mwerjaro's camp, Mwaliki, North Wamia.

I obtained rats from native houses, and the natives themselves brought in a few hundreds, all the house rats were found to be, not *Rattus rattus kijabius*, but a smaller species of rat of the multimammate type, brown in colour in aged animals, and the females with 10 pairs of mammae, as against the five to six pairs of the female *Rattus rattus kijabius*. The habits of these brown rats differ from those of *Rattus rattus kijabius*.

The *Rattus rattus kijabius* I usually found in the grass roof of native huts and corn-bins, with nests in the thick thatch near the top of the cone, these brown multimammate rats lived and had their nests in holes in the mud walls and floors, and one had to dig to obtain them, and practically none were found in the corn-bins during the day-time; this brown rat the natives informed me was the "Muunchu," which in the southern location has been ousted by the *Rattus rattus kijabius*.

The rat I usually found in the corn-bins in this part of the country was the field rat, *Arvicanthis sp.* (?).

Thinking perhaps the Malikisi river had formed a temporary barrier to the advance of the *Rattus rattus kijabius* in this part of the location, I walked back one day to the river and examined bomas on each bank, all the rats obtained, however were *Rattus rattus kijabius*, and it was not till I had reached a village 2-3 miles north of the river did I find both *Rattus rattus kijabius* and multimammate; here I found both species in the same house.

I may here mentioned that at the point examined, the Malikisi river is bridged, but from the bomas on the north bank I could obtain no history of plague.

From Mwaliki I safaried north to Walagu then south to Malikisi, and then east through Busakala, Kiruis to Marungas, from villages in all these districts were obtained nothing but the brown multimammate. But while camped at Malikisi I made a short safari to Thurianga, South Kitosh, situated just east of the Malikisi river, here I again found the junction of the *Rattus rattus kijabius* and multimammate; but the advent of the *Rattus rattus kijabius* must have been of recent occurrence, as on my first arrival at camp, I was informed by the headman and others that the "Mbaachi," the native name for *Rattus rattus kijabius*—had not yet been found in their district, on personal investigation, however, I did find the *Rattus rattus kijabius*, but only in small numbers, 13 to be exact.

At the camp at Walagu was trapped the first of the little grey dormice collected, and the natives have an interesting story that the presence of this small rodent in a house is sufficient to scare away any species of rat; from my own observation I have found that in houses in which I have seen or trapped the dormouse no other kinds of rodent were present, but of course this cannot be accepted as proof positive.

From Marungas I marched down the eastern boundary of North Kavirondo, camping near the Kitosh Mission and again at the Nzoia river; at the former camp, only brown multimammates were found as house rats, but at the Nzoia river small numbers of *Rattus rattus kijabius* were brought in, and these I found in villages not far from the river Muji.

I then marched across country through Yalusi, Kaweri, Chuere to Sioya, Sudi's lower boma, and the further west I travelled the more abundant was the *Rattus rattus kijabius*, till at Sudi's boma I found practically no multimammates. Now, at this boma some seven months previously, the Chief Sanitation Officer, while on tour, found large numbers of the brown multimammate, but on my arrival in the beginning of October the multimammate had practically disappeared, and Sudi was already having plague, his own boma and another being attacked.

In the districts Yalusi, Kaweri, Chuere and Gongoli the natives reported that the *Rattus rattus kijabius* had been with them from three to four months only, and I could obtain no history of plague there.

From Sioya I extended my investigations north to Nalondo, Kabuiai, Serare, Nyangai and Shiwoti, obtaining *Rattus rattus kijabius* from all these places, but the further north I travelled the numbers of *Rattus rattus kijabius* decreased and those of the brown multimammate increased, till north of Nalondo were found only multimammates. Here, too, the natives informed me the *Rattus rattus kijabius* had arrived within the last 2-3 months only; in some of these districts—the limit of the distribution of *Rattus rattus kijabius* —the proportion of males to females was about equal, in other districts the males were in excess; now in the locations where *Rattus rattus kijabius* had been established for some time, the proportion of males to females was nearly always 1 to 2.

I could obtain no history of plague in any of the districts where only brown multimammate rats were found.

In the first week of October I returned south from Nalondo and marched to Mumias.

From Mumias I worked along south of the Nzoia river through Mukulu, Warebbe into Kabras, finding nothing but *Rattus rattus kijabius* along the march. At Kitanda's, however, I obtained small numbers of the brown multimammate rat, these came from villages near the foot of the Nandi Escarpment, while in the country N.E. of Kyebusai was found only the multimammate.

From Kabras I returned to Kakamega boma, and found awaiting me instructions from the Chief Sanitation Officer to proceed west and finish the survey of the Kenya Colony-Uganda boundary from South Wamia, Ohayo, Samia, through to Sio; this I did, killing large numbers of *Rattus rattus kijabius* in Wamia and Ohayo.

The natives here have a story that the invasion of *Rattus rattus kijabius* is of comparatively recent date, that is, since the Great War, and this rat is often called "Panya ya Germani"; only a native story however.

At Sio it was with great difficulty I obtained house rats for smear purposes, in 2½ days killing only five; there had been an outbreak of plague here in June, and the Medical Officer, Kisumu district, had had three large rat-kills, which facts probably account for the scarcity.

From Sio I returned to Nairobi, arriving there on November 28th.

I have said very little in this report concerning the various specimens trapped during the survey, but details will be found when the collection is worked out.

The collection does not by any means contain every species of small mammal to be found in North Kavirondo, the country covered is very large, and the time at my disposal was very short; nor could I make accurate and absolute observations as to the habits, breeding places, etc., of the animals caught, it would require at least a year's continuous work in one spot to acquire accurate information on these points.

During the whole of my survey I received the greatest possible assistance from both Administrative and Medical Officers, without it my work could not have been carried out.

I attach map showing the exact distribution of the *Rattus rattus kijabius* in North Kavirondo district, at the time of the survey; also figures showing the numbers and sexes of all the rats killed and examined.

(Signed) W. N. VAN SOMEREN

NAIROBI,
December 2nd, 1921.

GENERAL SANITARY WORK IN TOWNSHIPS.

NAIROBI.

Population.

European	2,929	
Goan	1,100	
Asiatic	8,005	
Native and others	12,343	(approximately)
Total	24,377	

Staff.

Medical Officer of Health	One
Qualified European Sanitary Inspectors	Four (average)
European Nursing Sister (child welfare work, etc.)	One

Scavenging and Cleansing and Removal of Night Soil.

It is with pleasure that one is able to record a marked improvement in the general sanitary condition of Nairobi during the year. Much very valuable work has been done at the instance of the Health Office Staff in the way of securing the cleansing of the many vacant plots in the town, while the scavenging service rendered by the Municipality has been distinctly improved. As a result open spaces, vacant plots, yards, passages and side walks can no longer be described as grossly littered and untidy. Many nuisances resulting from dilapidated or badly constructed latrines have been permanently abated, while the night soil removal service for which the Municipality is responsible has been more efficiently performed than in the past. The number of dilapidated or entirely unsuitable pail closets which existed in Nairobi at the commencement of the year was very large, and in order to ensure their replacement by latrines of a satisfactory kind a new type drawing for a fly-proof latrine was prepared.

The design is reproduced in this report as the type has proved satisfactory. The average cost has been Fls. 150/-.

It is the intention of the Municipality to introduce a modified double bucket service of night soil disposal during the ensuing year for the town generally, while for the more congested commercial quarter the installation of a water carriage system is being considered.

Housing.

Considerable progress has been made on the area reserved for a native location. Eight large septic tank latrines have been erected, and by the end of the year plots were available for occupation. It is doubtful, however, whether the arrangements which have so far been made are sufficient to solve the problem of the housing of the casual labourer. Reliance is at present being placed on an extention taking place of the present custom whereby the less well to do natives are accepted as lodgers by those who have been so fortunate as to amass enough capital to erect a house. There is no evidence, however, that this custom is likely to be extended so as to provide for the lowest class, and it would seem probable that the problem will not be solved without the incurrence of considerable capital expenditure by the Municipality on the erection of dormitories or lodging-houses.

Another aspect of the native housing problem also demands consideration. There is naturally arising in East Africa a class of native whose economic condition and technical training will put its members in a position to erect for themselves permanent housing of a very satisfactory kind.

The conditions of tenure in the native location are not such as would encourage the erection of such housing in that area, nor is it sufficiently extensive. The question of making provision for this class is obviously, from every point of view, a most weighty one and one which merits careful consideration both from the Municipality and from Government.

Routine Sanitary Work.

That a large amount of work, much of which will result in permanent improvement, has been carried out under the ægis of the Health Office is amply evidenced by the extracts from the report of the Senior Sanitary Inspector which are given below.

An endeavour has been made to achieve some permanent improvement in sanitary condition in Nairobi in addition to coping with the dead weight of routine work in connection with cleansing, licensing, etc. The severe industrial depression with its attendant financial embarrassment to so many property owners has rendered this endeavour particularly difficult so that much hard and persistent work has borne comparatively little fruit and in some cases none whatever. An examination of the summary of work done, however, shows that some permanent works have been carried through in spite of the prevailing difficulties.

29	Floors relaid.
127	Floors repaired.
20	Yards paved.
12	Passages paved.
22	New latrines erected.
88	Latrines reconstructed.
15	Latrines repaired.
46	Concrete trays to standpipes provided.
166	Yards of masonry drains laid.

These are items of work which give permanent benefits and are difficult of accomplishment, as they call for capital expenditure by owners and persistent effort and close supervision by Inspectors.

There is another class of work also which makes large demands upon time and energy, and which is somewhat of a negative character, leaving little or no evidence of hard work done, that is, the preventing of fresh insanitary conditions being brought into existence.

Unsanctioned building work of a most objectionable character is a constant evil in this town, and one frequently speculates as to whether the abatement of nuisances even keeps pace with the creation of new insanitary conditions. The temporary nature of the major portion of Nairobi structures —the wood and iron building—lends itself admirably to the evasion of the building bye-laws and adds difficulty to the detection and demolition of new objectionable building work.

The report shows 44 buildings demolished. The records of this office show that demolition work has always been a heavy annual item. Much more of this class of work remains to be done and the opening up of the native location and an asiatic reservation will make much of this work possible that has not been possible in the past. Some native housing is quite beyond description and nothing but complete demolition would meet the case.

A certain amount of overcrowding, sleeping in kitchens and stores, etc., has been stopped, but until the native location is fully developed effective work on these lines is hopeless, as one only succeeds in driving persons from one place to another and the evil continues.

An interesting fact in connection with so many Indian dwellings in the town is the entire absence of any kitchen accommodation. There is no law to compel the provision of kitchen accommodation, such provision being in the ordinary way the outcome of custom and usage. But difficulty exists when kitchen accommodation is the only reasonable solution of an unsatisfactory condition, and yet the owner refuses to provide such or the premises are so congested as to leave no room for a kitchen.

The dhobi and laundry quarters about the town are very unsatisfactory. Messrs. A. M. Jeevanjee & Co. are considering the erection of new dhobi quarters, and to assist towards the creation of new and satisfactory accommodation type plans have been drawn up at this office for guidance in the matter. It is hoped that progress will be made towards providing new model quarters in the forthcoming year.

To meet the demand for a cheap but sanitary type of pail closet type drawings have been produced of a fly-proof pail closet which can be erected at low cost.

A considerable number of these new type pail closets have been erected and have proved satisfactory. They are an undoubted improvement on the old type latrines.

A type drawing has also been made of a sanitary fly-proof pit latrine to meet requirements in residential areas.

SUMMARY OF THE WORK OF ALL INSPECTORS.

House to House and General Inspections.

First inspections	7,266
Subsequent inspections	2,806
	10,072

Sanitary and other Notices Served.

Served during the year	887
Not proceeded with	34
Complied with	782
Outstanding	71

Results of Notices and Inspections.

Premises demolished	44
,, closed	21
,, cleansed	185
,, limewashed or painted	224
,, floors relaid	29
,, floors repaired	173
,, yards or plots cleared of rubbish ...	98
Deposits of refuse, stones, etc., removed	106
,, of refuse, stones, etc., stopped	41
Areas cleared of long grass, bush, etc.	389 acres

Yards paved	20	
Passages and open areas paved	12	
Yards cleansed	74	
Passages and open areas cleansed	22	
New latrines provided	22	
Latrines condemned	93	
Latrines reconstructed	88	
Latrines repaired	15	
Sanitary buckets provided	95	
Masonry or concrete trays provided to standpipes	46	
Dustbins provided	135	
Dustbin lids provided	55	
Masonry or concrete drains provided	166	yards
,, ,, ,, relaid or repaired ...	270	,,
Masonry or concrete drains cleansed	541	,,
Premises provided with trestles for stacking foodstuffs	43	
Sets of trestles for stacking firewood provided ...	11	
Huts burned	4	
Kitchens provided	21	
Store rooms provided	14	
Earth drains cut	855	yards
,, ,, re-cut and cleansed	3,362	,,
Borrow pits and hollows filled in	52	
Waste pipes provided	43	
,, ,, repaired	23	
Soakaway pits provided	6	
,, ,, cleansed	8	
Cattle sheds and bomas closed	1	
,, ,, ,, cleansed	19	
Overcrowding stopped	21	
Sleeping in kitchen and stores stopped	25	
Mosquito breeding places dealt with	27	
Unclassified nuisances abated	173	

LICENSED PREMISES.

Description.	No. of Premises.	No. of Inspections.	Licenses applied for.	Licenses approved.	Licenses not approved.
Aerated Water and Ice Factories	6	92	3	3	—
Bake Houses	9	101	10	9	1
Butchers	25	146	33	23	10
Cattle Sheds and Stables ...	24	104	1	1	—
Eating Houses	25	325	56	29	27
Fishmongers	2	6	3	3	—
Dhobies and Laundries ...	9	57	11	11	—
Lodging Houses	—	—	—	—	—
Trade premises	510	1,362	457	431	26
Vegetable sellers	14	91	15	12	3
Sweetmeat sellers	10	57	8	7	1
Total	634	2,341	597	529	68

PROSECUTIONS.

No. of cases.	Convictions.	Cases lost or withdrawn.	Penalties.
67	64	3	Fls. 736

FOOD INSPECTIONS.

Milk	217 samples
Aerated Water	12 ,,
Ice	1 ,,

Meat and vegetable inspected daily at the market and on licensed premises. Samples of the pipe water supply, irrigation canal water and Nairobi river water have been taken from time to time.

FOOD CONDEMNED.

Milk (approximately)	193 gallons.
Meat (,,)	2,374 lbs.
Fruit and vegetables	100 ,,

MOMBASA.

POPULATION.

European	656	Census, 1921.
Goan	724	
Asiatic	7,575	
Arab	5,461	
Native	17,983	(estimated).
Total	32,399	

STAFF.

Medical Officer of Health	1
European Sanitary Inspectors	3
Nursing Sister	1

SCAVENGING AND CLEANSING AND THE REMOVAL OF NIGHT SOIL.

The above work in Mombasa is now carried out by a Sanitary Inspector of the Medical Department under the superintendence of the Medical Officer of Health.

The improvement which was noted in last year's report has been maintained and many further improvements have been effected. Night soil disposal was until recently effected by means of open tip waggons which were conveyed on a trolley line which ran through the Island to a point on the foreshore where the contents were dumped over a chute irrespective of the state of the tide. At times a very considerable nuisance resulted. During the year the trolley lines were removed and the further use of tip waggons became impossible. As bullock transport is not possible on the Island and motor transport seemed likely to prove uneconomical on account of the short hauls and the comparatively small number of buckets to be dealt with, it was decided to replace the tip waggons with hand carts. These latter are two-wheeled and are constructed to carry twelve very large covered buckets into which are emptied the contents of the pails from the various latrines. Four such carts are in use and are sufficient to deal with the night soil from over three hundred pail latrines. Each cart is in charge of a headman and five sweepers who are responsible both for collection and haulage.

In order to obviate the nuisance which previously occurred owing to dumping into the sea over an open chute, irrespective of wind and tide, a small sewage disposal station was erected during the year near the site of the old chute. A drawing of this station is attached. It consists of a covered washing shed into which the carts with the buckets are hauled and a "holding up tank." There is a large opening in the floor of the shed leading to the tank and a copious water supply is available. The shed is well lit with electric light and well ventilated. On the arrival of a cart the buckets are uncovered, emptied and thoroughly cleansed and scrubbed. The cart is then cleansed and scrubbed to remove any spillings and the buckets are replaced. Lastly, the sweepers themselves get under the hose. The whole process for one cart does not take more than ten minutes, and it is possible to remain in the shed throughout the operations without discomfort. The contents of the tank are held up till the next outgoing tide, when they are released and are carried out to the sea without any nuisance resulting.

The above operations are carried out at night, while the cleansing of the pails in all pail closets and public latrines is carried out during the day time at each latrine by a day gang. This last proceeding is obviously not an entirely satisfactory one and to obviate it 600 pressed steel sanitary buckets (Brains No. 10) and 300 air-tight lids have been purchased, and a complete double bucket system will shortly be established.

The replacement of all insanitary or dilapidated pail closets by suitably designed fly-proof latrines is in progress and seven new six-seated public latrines are in course of erection. A drawing of the type single-seated native latrine, as issued by the Health Office, and a photograph of the same, are included in this report. The walls are shown of the thickness which is most suitable for construction in the local material—coral.

The pail system is only in vogue in the European residential quarter, some parts of the newer commercial areas and for public latrines. In the native quarter and in the old Arab town pits are almost universally used, and on account of the nature of the subsoil—coral—and the great depth of the ground water level—from 50 to 70 feet—are exceedingly satisfactory. A few domestic water borne sewage disposal installations draining into pits in the coral are now in use in the European quarter and have proved satisfactory.

STREET SCAVENGING AND REFUSE REMOVAL.

This work is carried out in a very thorough and efficient manner and the many miles of narrow lanes and passages in the Arab and native towns have been kept clean and tidy. The town is divided into 14 districts, each of which is in charge of a headman and eleven scavengers. Three journeys are made daily by each gang to the destructor with the refuse collected. Hand carts (four-wheeled), fitted with removable sides and ends and of a capacity of 51 cub. ft., are employed for the removal of refuse. Approximately 2,181 cub. ft. are collected and destroyed per day. All refuse is disposed of in a four-celled Horsfall Destructor and no difficulty is experienced in disposing of this amount, even in the wet season, though during the latter period a certain amount of oil and fuel has occasionally to be used to facilitate the destruction of refuse which has become particularly sodden.

A new enclosed iron drying shed, with a concrete floor, and a large cart shed have been erected during the year at the destructor.

The manner in which this destructor is run, the extreme tidiness and cleanliness of the surroundings and the entire absence of litter at all times of the day, reflect particular credit on the Inspector in charge of Conservancy.

HOUSING.

An unusually large amount of work in the direction of gutting and remodelling insanitary premises in the old Arab town was carried out during the year under the superintendance of the Department's Sanitary Inspectors, while the prevention of unauthorised alterations or unauthorised new building received constant attention both from these Inspectors and from the Building Inspector.

The problem of relieving the overcrowding which exists in many parts of the African town and of making adequate provision for the influx of Africans which will undoubtedly follow a revival of trade, remains unsolved. A partial solution will doubtless be found so soon as more easy and direct access to the mainland may be established, but it is to be hoped that before such access is established, adequate provision will have been made for the regulation of the new suburbs which will come into existence.

Town Planning.

A very large amount of preliminary work has been accomplished and a complete survey of all plots and premises in the island is now in existence. A draft road scheme is nearing completion. Further progress will largely depend on the staff and funds which may be available to carry this scheme into effect, to amplify it and to guide the future growth of the town. The town planning of Mombasa is undoubtedly one of the most important public works now before Government, and it is earnestly to be hoped that the necessary funds and staff will be available. It is perhaps not sufficiently realised that the town planning of Mombasa is a work of more than purely local interest. The convenient arrangement of any port town is of importance not only to shipping but to many wide commercial interests, while the sanitary condition of Mombasa when it will have become, as would not appear unlikely, one of the largest and most important shipping centres on the Indian Ocean, will be a matter of concern to most other seaports of importance. There is practically a clean slate at present, and future convenience and health can still be ensured, but the first premium must be paid at an early date.

Markets.

An important work of a permanent nature was the completion of the large Mackinnon Market on Salim Road.

Routine Sanitary Work.

The reports of the two Sanitary Inspectors who were engaged on routine sanitary work throughout the year are given below.

SANITARY INSPECTOR'S REPORT FOR MOMBASA TOWNSHIP FOR THE YEAR ENDING 31st DECEMBER, 1921.

TABLE I.

LICENSED PREMISES.

Licenses Recommended.

Class of Premises.	Applied for.	Approved.	Not Approved.
Aerated Water Factories	3	3	—
Bakeries	7	6	1
Butchers	—	—	—
Cattle Sheds	9	1	8
Dhobies	29	19	10
Eating Houses	38	29	9
Fishmongers	—	—	—
Hotels and Bars	8	7	1
Ice Factories...	1	1	—
Lodging Houses	7	5	2
Milk Sellers	—	—	—
Tembo Shops	1	1	—
Vegetable Sellers	2	—	2
	105	72	33

TABLE II.

INSPECTION OF LICENSED PREMISES.

Class of Premises.	No. of Premises.	Inspections made.
Aerated Water Factories	3	50
Bakeries	6	91
Butchers	—	—
Cattle Sheds	1	10
Dhobies	19	182
Eating Houses	29	553
Fishmongers	—	—
Hotels	7	72
Ice Factories	1	13
Lodging Houses	5	59
Milk Sellers	—	—
Tembo Shops and Bars	1	9
	72	1,039

TABLE III.

COMPLAINTS.

Complaints received	19
Premises inspected	19

TABLE IV.

MOMBASA WATER SUPPLY.

Applications made	32
,, approved	21
,, not approved	11
Inspections made	51

TABLE V.

SANITARY AND GENERAL NOTICES.

Notices served during the year	226
,, outstanding from last year	21
,, not proceeded with (2nd notices served) ...	—
,, cancelled	9
,, complied with	234
,, outstanding	4
,, final served	51

TABLE VI.

RESULTS OF INSPECTIONS AND NOTICES.

Premises repaired, cleansed and limewashed ...	1,467
,, demolished	20
Cesspools repaired	76
,, closed	31
,. constructed and provided with covers ...	37

TABLE VI.—*continued.*

RESULTS OF INSPECTIONS AND NOTICES.—*continued.*

Plots cleared of bush, rubbish, etc.	42
Dustbins provided	61
Sullage pipes cleared, repaired and provided ...	119
Goods stacked on platforms	7
Pail closets (H.O. type) erected	12
Floors relaid and repaired	110
Cattle sheds removed	22
Wells closed	10
Nuisances abated in connection with Mombasa water supply	11

TABLE VII.

MOSQUITO PREVENTION.

Works carried out during the year.

Breeding places abated by oiling, etc.

Wells, weekly oiling	36
Rainwater tanks and cesspools, weekly oiling ...	745
Area (approx.) cleared of bush, etc.	125 acres
Loads of tins, etc., buried	3
Approx. number of inspections by native inspectors	4,300

TABLE VIII.

DISINFECTION.

Premises disinfected	1
Number of rooms	3
,, of articles disinfected (approx.)	700

All public Rickshaws and Motor Cars.

TABLE IX.

FOOD, ETC., INSPECTIONS.

Class of food, etc., inspected.	Quantity inspected.	Quantity condemned.
Mutton	As far as possible market inspected daily.	875 lbs.
Beef		1,784 ,,
Guts	—	5 ,,
Lungs	—	43
Ox heart	—	23
Rice	—	48 bags.
Camel flesh	—	200 lbs.
Onions	—	320 ,,
Dhall	—	13 bags.
Milk condensed	—	5,632 tins.
Tinned Pears	—	48 ,,
Chillies	—	85 bags.
Preserved meat	—	160 lbs.
Ox tail	—	1
Cocoa	25 cases	25 cases.
Ox tongues	—	3

TABLE X.

INSPECTIONS BY EUROPEAN SANITARY INSPECTORS.

Nuisance and general inspections (approx.) ...	4,000
Licensed premises inspections	1,138
Disinfection inspections	1
Water Supply inspections	51
Food, etc., inspections	360
Total ...	5,550

TABLE XI.

BUILDING PLANS.

Number of plans submitted	48
,, ,, recommended	21
,, ,, sent back for alterations ...	6
,, ,, not recommended	21

TABLE XII.

BUILDING APPLICATIONS.

Number of applications submitted	219
,, ,, recommended	160
,, ,, sent back for alteration	1
,, ,, not recommended ...	58

TABLE XIII.

PROSECUTIONS.

Class of Prosecution.	Number.	Withdrawn.	Lost.	Convictions.	Fines.
Building Rules	2	—	—	2	250/-
Licensed premises Rules ...	7	2	1	4	145/- and 1 with 3 days' imprisonment.
Mosquito Rules	1	—	—	1	5/-
Nuisance Rules	3	—	—	3	65/-
Masters and Servants Ordinance	1	—	—	1	75/-
	14	2	1	11	540/-

The two cases withdrawn were in connection with the Mzizima cowsheds, an undertaking was given in court that the cowsheds would be entirely removed, we agreed to this.

The cowsheds were all duly removed.

Four closing orders were obtained during the year.

Two nuisance orders were also obtained.

SANITARY INSPECTOR'S REPORT FOR MOMBASA TOWNSHIP FOR THE YEAR ENDING 31ST DECEMBER, 1921.

TABLE I.

LICENSED PREMISES.

LICENSES RECOMMENDED.

Class of Premises.	Applied for.	Approved.
Aerated Soda Factories	1	1
Bake Houses	2	2
Eating Houses	41	39
Tempo Shops	12	12

TABLE II.

INSPECTION OF LICENSED PREMISES.

Class of Premises.	No. of Premises.	Inspections.
Aerated Water Factories	1	74
Bakeries	2	85
Butchers and meat sellers	1	33
Eating Houses	39	240
Hotels	1	21
Tembo Shops and Bars	12	94

TABLE III.

COMPLAINTS.

Complaints made	41
Premises inspected on complaint	41

TABLE IV.

SANITARY AND GENERAL NOTICES.

Notices served during the year...	418
,, outstanding from last year	—
,, cancelled	2
,, complied with	398
,, outstanding	18

RESULTS OF INSPECTIONS AND NOTICES.

Premises repaired, cleansed and limewashed ...	232
Cesspits repaired	3
,, filled in	8
,, constructed and provided with covers ...	39
Carried forward ...	282

TABLE IV.—*continued.*

RESULTS OF INSPECTIONS AND NOTICES.—*continued.*

Brought forward ...	282
Plots cleared of bush, etc.	22
Depositing of rubbish stopped	3
Dustbins provided	38
Rainwater tanks repaired	34
,, ,, removed	13
,, gutters removed	10
Wells closed	11
Pail closets erected	39
Mosquito breeding places and likely mosquito breeding places abated	2,536
Improvements effected and nuisances abated at licensed premises	146
Total ...	3,134

TABLE V.

MOSQUITO PREVENTION.

WORKS CARRIED OUT DURING THE QUARTER.

Wells	85
Barrels	—
Rainwater tanks emptied	554
Cesspools and soakaways	1,881
Pools	16
	2,536

Area (approx.) cleared of bush	250
Holes, borrow pits, etc., filled in	17
Amount of material used (cartloads)	—
Loads of tins, etc., buried	—
Number of native mosquito inspectors	2
,, of inspections by native inspectors (approx.)	7,200

TABLE VI.

DISINFECTION.

Premises disinfected	7
Number of rooms	20

TABLE VII.

FOOD INSPECTIONS.

Class of food, etc., inspected.	Quantity inspected.	Quantity condemned.
Fruit	59 tins.	59 tins.
Chocolate	27½ lbs.	27½ lbs.
Vermouth	5 bott.	5 bott.
Beer	21 ,,	21 ,,
Sundry groceries	202 lbs.	202 lbs.
Tins, milk	43 cases.	43 cases.

TABLE VII.—*continued*.

INSPECTIONS.

By European Inspector.

Nuisances and general inspections	2,920
Licensed premises inspections	524
Disinfection inspection	7
Total by European Inspector ...	3,461

TABLE VIII.

REPORTS ON PLANS.

Number of plans submitted	10
,, ,, recommended	9
,, ,, sent back for alterations ...	—
,, ,, not recommended	1

TABLE IX.

BUILDING APPLICATIONS.

Building applications submitted	304
,, ,, recommended	242
,, ,, not recommended	62

TABLE X.

PROSECUTIONS.

2 unregistered lodging houses	1 cautioned.	
	1 fined ...	Fls. 75.00
29 cases for breeding mosquitoes, total fines		Fls. 55.50
	Total ...	Fls. 130.50

KISUMU.

Staff.

Medical Officer of Health	One.
European Sanitary Inspector	One (during part of the year only).

Scavenging and Cleansing and the Removal of Night Soil.

In Kisumu the above work is not under the direction of the Health Officer, but is carried out by the Superintendent of Conservancy, who is responsible to the administration.

It has, as usual, been executed in a most satisfactory manner, and the trenching ground is a model of what such a place should be. The town continues to be probably to cleanest and best cared for in the country, and the Medical Officer of Health's Report is a record of the large amount of careful work which is necessary to maintain it in that condition.

CHILD WELFARE, ETC.

Both at Mombasa and at Nairobi a qualified Nursing Sister was on duty throughout the year. A large number of visits were made, a considerable amount of vaccination of infants and women and children was carried out and advice given with regard to the treatment of minor ailments, the care of the eyes, etc., etc. The work of these ladies which is not carried out under the easiest of conditions has been exceedingly careful and painstaking and is coming to be appreciated and valued by the African and Asiatic populations. It is very greatly appreciated by the Medical Officers of Health and by the Department generally.

SHIPPING.

BILLS OF HEALTH ISSUED.

Port.	1919.		1920.		1921.	
	Steamers.	Dhows.	Steamers.	Dhows.	Steamers.	Dhows.
Mombasa	178	480	264	311	322	463
Lamu	1	203	—	105	101	
Kismayu	14	104	48	140	140	

Four steamers which arrived at Mombasa infected with Small-pox were sent to the Sanitary Station at Zanzibar for disinfection and quarantine of deck passengers.

Forty-nine dhows from Gazi were disinfected and kept under observation on account of Small-pox prevailing in that district.

S.S. *Llanstephan Castle* was kept in quarantine on 21/8/21 as a case of Small-pox among the Officers was removed at Zanzibar.

IV.—HOSPITALS AND DISPENSARIES.

1.—EUROPEAN HOSPITALS.

The long-needed European Hospital at Kisumu came into being at the end of March, and was established in a bungalow previously in occupation by the Uganda Railway. The accommodation provided is for six beds, and all these have been occupied on more than one occasion. While the building is by no means ideal, yet an enormous boon to the community is conferred by the establishment of an institution where skilled nursing is obtainable and where medical aid is always at hand. In addition to the advantage to the district is to be reckoned the saving in time to the medical staff. Whereas, previously, medical officers were summoned to outlying parts of the settled areas in the Nyanza Province, now patients come into Kisumu and the time saved is devoted to the more legitimate work of the Medical Department. In all, 50 cases were treated at the European Hospital, Kisumu, in the nine months of its existence.

Improvements were effected during the year at the existing hospitals. At Mombasa an operating theatre has been devised on one of the verandahs by a system of roller blinds which are pulled down when an operation is taking place, the area being open to the sun at other times. An adjoining small room is used as a sterilizing room. As a makeshift the arrangement is satisfactory. A further improvement has been effected at Mombasa in the provision of increased accommodation for the nursing staff. As was noted in last year's report the existing accommodation was quite inadequate for the necessary nursing staff. During 1921 a small bungalow adjacent to the hospital was assigned to the nursing sisters and the reasonable facilities and comfort now afforded them can only result in increased efficiency and a decrease in sickness.

At Nairobi, adequate housing has been provided for the menial staff employed, and it has been possible to establish a laundry in the buildings erected. This latter has already proved its usefulness in the rapid return of articles sent to the wash and has effected a saving of almost £100 per annum in upkeep. An even more important improvement has been effected by the discovery locally of an X-ray expert, who has been able to put the X-ray apparatus, previously condemned as useless, into first-class working order at a relatively trifling cost.

The total number of cases treated in the various European hospitals shows a slight increase over the total of last year, as set forth in the following table :—

	1921.	1920.	1919.
Total number of beds	46	34	27
Total number treated	667	608	500
Total number discharged	618	552	452
Total number of deaths	27	22	24
Total number remaining	22	34	24

Of the above, 195 were officials as against 176 in 1920, with 472 general European population as against 432 in the preceding year. Four officials died and 23 non-officials, as against 3 and 19 in 1920.

The distribution of the various cases was as follows :—

	Officials.	Non-officials.
Mombasa	58	112
Nairobi	105	297
Eldoret	12	33
Kisumu	20	30

Malaria was, as usual, the chief cause of admission, the numbers being 198, 29·6 % of the total, and of these 115 cases were treated at Mombasa.

Diseases of the enteric group showed an increase, the total being 42 as against 28 in 1920, but this large increase was due to the identification of cases of paratyphoid.

A large increase is again recorded for cases of surgical disease and surgical operations. The totals of operations performed were :—

Mombasa	28
Nairobi	194
Eldoret	22
Kisumu	nil.

The results have been all that could be wished for. It is recorded that at the European Hospital, Nairobi, no clean cases have shown any sign of suppuration, a testimony to the technique of all concerned. The cases were of every variety and every degree of severity. Six deaths occurred after the operation, as follows :—

Mastoiditis with infection of the lateral sinus and septicæmia.

Acute appendicitis and general peritonitis.

Intestinal obstruction by a band after removal of an acute appendix.

Ruptured ovarian cyst and general peritonitis.

Lion maul involving the knee joint, for which amputation of the thigh was performed.

Intestinal obstruction following on appendicitis.

Two interesting cases are outlined :—

The first case was that of a young police constable who had a discharging branchial fistula at the anterior margin of the sterno mastoid, 1 inch above the manubruium sterni.

At operation there proved to be a patent duct covered with muscular tissues, through which a probe could be passed into the pharynx. The duct ran up anterior to the carotid sheath then passed between the internal and external carotid deep to the digastric muscle and superficial to the facial artery. The whole duct was dissected out and removed, the stump being overstitched at its junction with the pharyngeal wall. The wound healed by first intention.

The second was that of a middle aged Swede, who was admitted with an acute mastoiditis. After the mastoid was drained he did not do well, so a further exploration was undertaken. The lateral sinus was not infected, but a large extra and intra dural abscess was opened in the middle cerebral fossa. This was drained and for a time he did well. He then started having rigors, daily temperature to 104° and very rapidly went down hill. As there was no sign of any further cerebral mischief, blood cultures were made and a pure culture of streptococci obtained. He was then given grs. 2 antimony tartrate intravenously every other day. After the third injection he had no more rigors, and his temperature reverted to normal. Injections were continued for three weeks. After three weeks his temperature again rose and fluid was present in the left chest. This was found to be pus. A rib resection was immediately performed and a large quantity of pus evacuated. Fourteen days later another collection of pus was evacuated from the right chest. All wounds healed perfectly. After the right chest was drained, patient immediately started to recover. When last seen, four months after discharge, he had regained his usual weight and was back at his work as farm manager.

2.—THE NATIVE HOSPITALS AND DISPENSARIES.

In common with the European Hospitals, various improvements have been effected at the Native Hospitals.

There seems to be no prospect, unfortunately, of the building of a new hospital at Nairobi, and it appears that the old out-of-date and inconvenient buildings will have to be utilized for some time. The posting of a nursing sister at the Native Civil Hospital, Nairobi, has been followed by the good results which were described in last year's report as accompanying a similar appointment at Mombasa. The standard of nursing and attendance on the sick on the part of the native dressers has improved and the numbers of admissions of women and children have gone up very considerably, while the services of a trained sister in the operating theatre are reflected in the improved results of operations and inspire confidence in the undertaking of serious cases.

The institution of hospital uniforms and a pack store at Nairobi has been followed by excellent results. The patients own rags and skin clothing are taken away, sterilized and stored and each is issued with his hospital clothing, blankets, plate, etc., which he returns on discharge. Not only is there a resulting increase in cleanliness and a decrease in the amount of vermin, but the patients become more like hospital patients than merely individuals residing for a time in a hospital, and last, but not least, the decrease in losses of hospital stores from pilferage is astonishing.

The issue of hospital clothing has been extended to the other large hospitals, and the pack store system is also being adopted.

Accommodation for the treatment of venereal diseases has been provided at Mombasa by the conversion of an old disused latrine to provide irrigation facilities, while at Nairobi a small wood and iron building has been erected with a compartment for irrigation and another for the examination of patients and the giving of intravenous injections. At Mombasa, Nairobi and Kisumu separate wards are set apart for venereal cases. The venereal ward at Kisumu is an addition to the previously existing hospital accommodation brought about by the removal of a disused wood and iron building from the Health Office and its re-erection in the hospital compound with a cement floor and walls composed of native matting.

During the year, after various trials, a new type of bedstead has been evolved for use in native hospitals, and has proved a success. The design is that of the Indian charpoy, but the legs and sides are made of seasoned and turned wood and the parts are all interchangeable, while the string mattress is replaced by a strip of stout canvas with brass eyelet holes which is laced on to the frame. The bed can be taken to pieces in a few minutes, and this being done regularly and the canvas washed and boiled, enables the bug problem to be dealt with.

The figures for in and out patients at native hospitals for 1921 show a gratifying increase in the totals and an equally gratifying decrease in the deaths and death rate. While no doubt a large proportion of the increase is due to the extension of facilities in native reserves, these figures being incorporated in the subjoined table, yet at the same time the numbers admitted to the old-established hospitals have gone up and it is quite evident that natives are beginning to regard the Government institutions as places where they receive sympathetic attention for their ailments. The increase in totals of admissions to hospital occurred generally throughout the country, and at Kisumu, in particular, the daily average of in-patients rose during the year from the neighbourhood of 30 to over 90.

The proportion of admissions of women and children is on the increase, and this, though gratifying in itself, raises the problem of the provision of female attendants. It is difficult to obtain satisfactory male dressers, but the difficulty is vastly increased when it comes to the question of female subordinates.

	1921.		1920.		1919.	
	In.	Out.	In.	Out.	In.	Out.
Admissions	23,634	154,198	20,001	109,737	14,371	95,574
Deaths	809	—	854	—	1,112	—
Death rate per 1,000 of admissions	34·23	—	42·69	—	77·37	—

The record of admissions to hospital is a fair index of the work done during the year.

GENERAL REMARKS.

Analysis of the figures of admissions to hospital throughout the country reveals the following :—

	In-Patients.			Deaths.		
	1921.	1920.	1919.	1921.	1920.	1919.
European Officials	592	574	748	4	4	15
Native Officials	3,951	4,439	4,703	10	12	15
General European Population ...	728	858	525	31	29	20
General Native Population ...	23,634	20,001	14,371	809	854	1,112

The only outstanding feature of the above table is the large increase, already commented on, in the numbers relating to the Native General Population. There is a slight increase in the figures for European Officials and a decrease for Native Officials and European General Population.

The lack of facilities for research at places other than Nairobi is not less felt than in previous years, and though the laboratory staff has been brought up to full strength, it has only been possible on one occasion to detach a pathologist for a short time to procure material in the field for investigation. It has, however, been possible on account of the sudden rush of appointments and the small number of medical officers on leave, to attach new arrivals to the laboratory for varying periods, and the experience gained in this way will, it is hoped, not only render officers more independent in the matter of microscopical diagnosis, but will strengthen the relationship between the laboratory and the Medical Officer in the field which is the basis of all scientific investigation with regard to disease.

PREVAILING DISEASES.

Malaria.—In spite of the increase of admissions to hospital during 1921, the total number of cases of malaria shows a considerable drop, probably due to the general shortness of rain which was experienced throughout the country. The incidence of the various types of malaria as shown by figures obtained at the laboratory, shows that the sub-tertian variety, as noted in last year's report, is much the most common in the district around Nairobi. It is interesting to note the figures as shown by the laboratory results, and a table is inserted which shows at a glance how the incidence of the various infections have varied during the war, pre-war and post-war periods in the Nairobi district :—

	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
Sub-tertian ...	238	209	174	218	814	655	881	435	540	224	83
Benign-tertian ...	25	19	12	10	61	176	607	308	90	44	19
Quartan	13	13	4	10	22	27	11	7	12	10	4

It is unfortunate that the only figures available with regard to the variety of malarial infections which prevail in the country are those which refer to the neighbourhood of Nairobi, but I hope, in future, to be able to give figures for other districts. It is unnecessary to remark that the staining and examination of slides is a large tax on the time of a busy medical officer, and with the absence of laboratory facilities elsewhere than at Nairobi, it cannot be expected that microscopical diagnosis can be made in more than a small number of cases. No additions have been made during the year to our knowledge with regard to the distribution and rôle of the various species of mosquitoes and without an entomologist attached to the Medical Department it does not appear probable that any extensive investigation will be conducted in the near future in this direction.

Blackwater Fever.—There has been an increase in the number of blackwater fever cases which have come under notice. As mentioned in last year's report, it does not follow that there is official cognizance of all the cases which occur, and it is therefore possible that the 1921 increase is more apparent than real.

The figures for the past two years are:—

	Cases.	Deaths.
1921	28	5
1920	13	4

Plague.—The outbreaks of plague which existed at the close of 1920, notably in the Nyanza Province and in the Nairobi district, continued for some time during 1921, but at the close of the year no cases of human plague were occurring in any part of the Colony or Protectorate. A large amount of work has been done and valuable information obtained with regard to some of the factors which are concerned with the epidemology of plague, and these, together with the whole story of plague in 1921, are fully dealt with in the sanitation section of this report.

The results of the rat campaign which was instituted at the beginning of the year in Kavirondo are also dealt with at length in the sanitation section, and it is not necessary here to do more than state that these results have far exceeded expectations.

Kala-Azar.—Two cases of kala-azar have come under notice as being contracted in the country, and both cases in the Northern Frontier District.

The first case was that of an Administration Cadet in his first tour of service, who had been stationed at the Northern Frontier and, with the exception of war service in France, had never been out of England prior to his departure for this country. The patient was admitted to hospital with pyrexia, which at first was thought to be due to paratyphoid, a positive reaction 1/160 having been given with paratyphoid B. The rapid enlargement of the liver and spleen which occurred caused a doubt to be thrown on the diagnosis and a liver puncture revealed the presence of Leishman-Donovan bodies. Treatment with tartar emetic intravenously which was rapidly worked up to grs. iii every other day at first had very good effects, but a relapse occurred in spite of the continuance of the drug. Later the symptoms abated and he was invalided home, but unfortunately died on the voyage.

Novarsenobillon was tried as an alternative in the above case when the relapse occurred, but there is no reason to think that the subsequent improvement was due to this.

Very soon after the discovery of the case already described, a Somali woman, the wife of an askari, was admitted to the King's African Rifles Hospital, with signs and symptoms of advanced kala-azar. The diagnosis was confirmed microscopically after the performance of liver puncture, but treatment was unavailing, the patient being almost in extremis when admitted. In this case the patient had just come down from the Northern Frontier District with her husband. Curiously enough, a third case occurred in the practice of a private practitioner in Nairobi, but this was a woman who had just landed from India, and there was no suspicion that the disease was contracted locally.

Trypanosomiasis.—During the latter three months of the year it was possible to detach a medical officer to carry out a survey of the shore of the

Victoria Nyanza with reference to sleeping sickness and the areas affected by the glossina palpalis. The results of this survey tend to show that in all probability the number of cases of sleeping sickness has slightly increased during recent years. This increase would seem to have resulted from the gradual return of the population to areas which had previously been deserted. From the report submitted, after the conclusion of the work, it would appear that in certain areas, notably Megeta Island, Homa Point and the Miriu River neighbourhood, a considerable proportion of the small population is affected, although there is nothing like the generalized incidence which occurred in the epidemic of 20 years ago. No new facts came to light with regard to the distribution of the glossina. The question now arises as to what is to be done in the future with regard to trypanosomiasis; is an effort to be made to control the spread of and to treat sufferers from the disease or are things to continue, as at present, with the constant danger of an epidemic? There can be no doubt that the wise and humane course is to endeavour to obtain some sort of control of the disease, and the only point to be considered is how this can be done in the cheapest possible way consistent with efficiency. In the past, anti-trypanosomiasis measures have varied from the removal of whole populations from infected areas and the promulgation of an elaborate code of rules and regulations as obtained in Uganda, to a practically complete absence of measures of any kind as the case in this country. The net result of the two systems, as far as the persistence of infection is concerned, would appear to be much the same, except perhaps in the case of island areas where it can be ensured that the removal of the population is absolute and complete. It is even possible that this country is in the better position, as it is not confronted with the difficulties of repopulation as are described by the Entomologist of the Uganda Protectorate in the Uganda annual medical report for 1920. The experience gained during the short time that medical facilities have been established in the Kavirondo Reserve would seem to indicate a line which might be followed with advantage. It has been abundantly shown in connection with the anti-plague campaign that once the confidence of the native has been obtained and a certain amount of propaganda carried out, it is a comparatively easy matter to get him to adopt measures directed to the prevention of disease when his energies are suitably supervised. The provision of facilities for the cure of disease is the best means which we have at our disposal for obtaining the native's confidence, and it therefore follows that the first step to be adopted in attempting the control of trypanosomiasis is to establish a hospital in the neighbourhood of the affected area where every variety of ailment can receive treatment. The existing hospitals are situated at a considerable distance from the sleeping sickness areas and the dislike of natives to leaving their homes when sick has prevented the inhabitants of trypanosomiasis areas from presenting themselves at these institutions, while the lack of communications has rendered it impossible for medical officers to visit the localities with any frequency. Given that the confidence of the population has been obtained, it is probable that a very large amount of clearing would be carried out by the people themselves if the reason for this step were to be fully and continuously impressed on them, thus obviating the necessity for legal enactments whose success or otherwise would probably depend on the efficiency and integrity of native overseers and inspectors. As pointed out by the Uganda Entomologist in the report already referred to, the tsetse fly is not one of the insect pests which increase and multiply with the extension of the human population, rather the contrary, human activities tend to decrease its sphere of influence and any means such as extension of trade facilities which would lead to the bringing into cultivation of large areas of the fertile land on the Lake shore would result in the curtailment of conditions necessary to its bionomics.

The absence of patients at the hospitals has prevented a trial of the methods of treatment advocated by Marshall and Vasallo in Uganda. It is hoped during 1922 to obtain a supply of the new drug, Bayer 205, and to find opportunities for its use.

Typhus.—Cases presenting the features of mild typhus have continued to occur, and, as previously, have only come under notice in the European population and in the cooler districts in the neighbourhood of Nairobi and Nakuru. In all, seven cases occurred, though no deaths resulted, yet the patients were in more than one case seriously ill. A description of the cases and the laboratory investigations in connection therewith will be found in the Laboratory section of this report. It will be noted that nothing new with regard to the etiology of the disease has come to light.

Dysentery.—The figures for dysentery remain at about the same level as those of last year, as shown in the following table :—

	Cases.	Deaths.
1921	1,174	46
1920	1,151	49
1919	2,626	274

and these, taking into account the fact that the totals of admissions have largely increased, would indicate that the incidence of dysentery has lessened.

Dysentery is another of the diseases about which our information is meagre from lack of laboratory facilities. The remarks made under the heading malaria with regard to the difficulty of the performing of microscopical examination by medical officers in charge of hospitals and out-stations apply with particular force to dysentery, as a considerable amount of technical skill and experience is necessary to diagnose the entmœba hystolitica from another amœbæ which may be present, while it must be remembered that the absence of a positive microscopical finding with regard to amœbæ even after a number of examinations is not necessarily a sufficient reason for the diagnosis of the condition as being of bacillary origin.

Typhoid Group.—The figures for this group of diseases show an increase over those for 1920, though the cases did not occur in other than a sporadic fashion :—

	Cases.	Deaths.
1921	42	6
1920	28	—

Of the above total, only 9 are reported as occurring in non-Europeans. It is probable that if more routine laboratory examinations were possible it would be found that the incidence of infections of the typhoid group among natives much higher than the above figures would indicate.

As foreshadowed in the report for 1920, the figures obtained at the laboratory, and which are given below, show that there is a large incidence of paratyphoid infections :—

Typhosus	2
Paratyphoid A.	11
Paratyphoid B.	4

Leprosy.—The totals which have been reported under this heading for the last three years are as follows :—

1921	42
1920	25
1919	18

There is no doubt that the above figures are no criterion as to the amount of leprosy which exists in the country, nor are we likely for some time to come to be in a much better position as regards our knowledge of the incidence of this disease unless the new forms of treatment are found to be a success and unless they can be applied, if necessary, on a large scale. Two leper settlements exist, one at Malindi and the second in the neighbourhood of Lamu, where Government maintains such lepers as are willing to stop and whose friends cannot or will not support them. A small native leper settlement also exists near Kakamega, in North Kavirondo, and a few patients are housed at the Infectious Diseases Hospital, Mombasa. The settlement near Kakamega being within easy reach of a medical officer has rendered it possible to attempt treatment of a small number of cases and in the latter part of the year the following drugs were tried on different cases :—

I.—Antimony Potassium Tartate.
II.—Sodium Hydnocarpate.
III.—Sodium Hydnocarpate and Sodium Morrhuate.
IV.—Oleum Morrhuate.
V.—Oscol Stibium.

It is perhaps too early to draw conclusions, but the results to date have not been encouraging.

Pneumonia.—The figures for pneumonia remain at about the same level as last year, the totals being :—

	Cases.	Deaths.
1921	1,233	254
1920	1,230	286

Tuberculosis.—288 cases were reported during the year, as compared with 254 in 1920.

It is satisfactory to note that the high incidence of tuberculosis which has occurred at the Nairobi Police Recruit Depôt since 1918 has disappeared, and that since July no cases have occurred. It is interesting to note briefly the various methods which were adopted to bring about the above desirable state of affairs. It was first thought that the site on which the lines were situated was at fault, the soil being black cotton and waterlogged during the rains. The housing itself was satisfactory and consisted of corrugated iron huts well ventilated and constructed on good concrete plinths and overcrowding was not evident. Numerous drains were cut and the level of the whole area was raised 9 inches by a layer of murrum. The fact that owing to the above step having been taken some of the floors of the huts were below the surrounding level was then thought to be at the bottom of the continued occurrence of cases and all huts were provided with removable wooden floors, while in a proportion the plinths were also raised. As the trouble was unabated it was decided in 1920, with a view to ascertaining whether the housing and surroundings were at fault, to place all new recruits under canvas on a good sloping, well-drained site, about a mile away from the depôt, while the older recruits remained in the lines. Cases continued to occur, however, both in the new camp and in the old lines. It was evident that housing conditions were not apparently to blame. The suggestion was then made that the physical drill with rifles which recruits had to undergo, and which has been abolished in the British Army, was possibly too severe and caused a lowering of resistance to either new or dormant infections. This form of training was therefore abolished and the adoption of a less severe form of drill was shortly followed by an entire cessation of fresh cases.

Venereal Diseases.—The comparative table for these diseases for the past three years is as under :—

	1921.	1920.	1919.
Syphilis	2,116	1,655	1,145
Gonorrhœa	1,209	1,299	1,298

It will be noted that while the cases of gonorrhœa remain at about the same level, the increase in the records of syphilis is maintained. The increased facilities which have been provided in the shape of venereal wards and the high opinion which the native has for novarsenobillon and allied drugs has undoubtedly caused an increase in the numbers applying for treatment for syphilis, but the less startling results obtained with gonorrhœa do not induce much desire to undergo this form of treatment, and its long continuance causes weariness and cessation of attendance.

In the present state of our knowledge we have no information as to the part which syphilis plays in the incidence of abortion and infantile mortality among the native tribes. Careful investigations with regard to this point are, however, at present being made in the Kavirondo country, and it is hoped that some exact information may shortly be available.

Yaws.—Our knowledge of the distribution of this disease has been considerably extended during the year. Yaws is found in many parts of the country and in certain areas, viz., South Kavirondo, the Giriama Reserve and in the Nyeri, Fort-Hall and Chuka districts of the Kikuyu Reserve the disease has assumed epidemic proportions and at any rate in the Fort-Hall area a very large number of the population is or has been at some time affected. It is a common occurrence when examining a Kikuyu from the Fort-Hall district as to a past history of yaws to receive the reply that the affection is not remembered, but that all babies have yaws, and examination almost invariably reveals the presence of scarring, especially at the angles of the mouth. It has been claimed that yaws is a disease of low altitudes; that is not the case in this country, as the affected Kikuyu district and South Kavirondo area range from an altitude of 3,000 feet to over 6,000.

The numbers of cases which have come under notice show an enormous increase over preceding years and are the result largely of the establishment of the medical centre at Kisii and the opening of a special camp during the year at Fort-Hall, where yaws cases could be accommodated and treated. The startling results of treatment with novarsenobillon have caused a demand which is steadily increasing and which may even swamp the medical staff and cause difficulty in the provision for a sufficient supply of the drug. It is probable that 1922 will show even larger figures, as the centre at Chuka, which was only opened at the end of the year, is situated in a yaws district, while the people from the Giriama country are beginning to come into Mombasa and Malindi to obtain treatment.

The actual figures are as follows :—

1921	7,401
1920	538
1919	515

These figures do not include cases treated at the Missions.

In connection with yaws a start has been made towards pathological research and a member of the laboratory staff proceeded to Kisii to obtain material in the field, but the amount which it has been possible to do is lamentably small and is confined to examination of the lesions in a small number of cases for the spironema and of the blood with regard to the Wasserman reaction and the leucocyte count. The results of the above are given in detail in the laboratory section of this report, together with photographs, which may give some idea of the plight of the yaws-ridden population. It is to be noted that the Wasserman reaction was strongly positive in the majority of cases, while the leucocyte count does not present any definite features. Further investigation is urgently necessary in this interesting disease with regard to the method of its spread and in particular in the direction of devising a test to differentiate it from syphilis, with which in so many respects it is closely similar and from which in a large number of cases it is impossible to make a diagnosis on clinical grounds. The fact that in districts such as Fort-Hall and Kisii cases of obvious primary and secondary syphilis do not present themselves in any numbers and that a very large proportion of the population suffer from secondary yaws is the only reason for making a diagnosis of yaws in many of the tertiary and a few of the secondary cases of that disease. There can be but little doubt that gangosa is a late manifestation of yaws.

The area in which yaws is epidemic in Kavirondo is demarcated almost abruptly from its surroundings, the Jaluo, a Nilotic people living near the shores of the Lake being the chief sufferers, while their neighbours the Kisii, of Bantu origin, are only affected where their territory impinges on that of the former and where a certain amount of contact takes place.

This would not appear to be the place to give a full clinical description of the disease, but the subject is one of intense interest. A visit to a yaws camp reveals at once that grey-headed elders and infants of a few months of age are affected and both present manifestations of the disease in its early stages.

The cases of tertiary yaws are frequently of the most horrible description and deformities and ulcerations of every type are common, hopeless contractions of the limbs are met with, perferations of the palate are of frequent occurrence, while destruction of the nose and upper jaw and face reminiscent of the worst cases of rodent ulcer are all too noticeable. A separation of the tertiary cases from the others would at once give the impression that the collection is one of the cases of untreated tertiary syphilis, though without the signs of congenital disease or the common lesions of the central nervous system.

The economic importance of yaws cannot be over-estimated, but in the absence of evidence that the disease is congenital—and there would appear to be strong reasons against its hereditary transmission—the problem of its eradication would appear to be reduceable to treatment and elimination of all outward manifestations. We have no knowledge whether one or two doses of novarsenobillon is enough to effect the therapia sterilans magna with the local type of yaws, though it is said to do so in other parts of the world, but we certainly do know that it will clear up secondary lesions like magic.

The method of treatment which is adopted in all cases is the intravenous or intramuscular injection of novarsenobillon and endeavour is made to give two doses to each patient at an interval of ten days, but a large proportion of cases do not present themselves for the second dose, presumably because all outward manifestations having disappeared, they imagine they are cured. During the year the various allied drugs, kharsivan, neokharsivan, neosalvarsan and galyl were given a trial, but the clinical results did not appear to be any better than those obtained with novarsenobillon, and the latter was adopted generally. The Medical Officer, Fort-Hall, made a trial of antimony tartrate, but found that the results could not be compared with those obtained with the arsenic compounds.

Beyond the administration of novarsenobillon the only other step which is adopted is the application of ordinary dressings to the larger ulcers.

Food Deficiency Diseases.—Cases presenting features of both beri-beri and scurvy have come under notice in fair numbers almost entirely from the fuel camps on the Railway, where fresh food is unobtainable at certain periods of the year and where the contractors are not too scrupulous with regard to the rations issued. The problem of the prevention of these cases resolves itself into the question of supervision to see that the food supplied is of good quality and that the scale laid down with its variation of diet is adhered to. The scale is as follows, and was published in the *Official Gazette* of August 24th, 1921 :—

"THE MASTER AND SERVANTS' AMENDMENT ORDINANCE, 1919.

RULES.

In exercise of the powers conferred upon the Governor-in-Council by Section 7 (2) (*b*) of the above Ordinance, His Excellency the Acting Governor-in-Council has been pleased to make the following Rules :—

1. These Rules may be cited as 'The Native Labourers' Diet Rules, 1921.'

2. These Rules shall apply to all fuel camps supplying the Uganda Railway between Samburu and Nairobi, any clause in any contract notwithstanding.

3. One item from each of the following four sections must be supplied daily to native labourers in fuel camps.

Section 1, Carbohydrates ...		Maize Flour,	18 oz.
	or	Matama	do.
	or	Mwele	do.
	or	Wimbe	do.
	or	Kimangari	do.
	or	Rice	do.
Plus Section 2, Proteids ...		Maharagwe,	6 oz.
	or	Pojo	do.
	or	Nbumbu	do.
	or	Kunde	do.
	or	Mbasi	do.
	or	Ground Nuts,	3 oz.
	or	Meat	6 oz.
Plus Section 3, Fats ...		Sim Sim seeds,	1 oz.
	or	Sim Sim Oil	2/3 oz.
	or	Ghee,	2/3 oz.
	or	Ground Nuts,	2 oz.
Plus Section 4, Vitamines ...		Potatoes,	8 oz.
	or	Muhogo	do.
	or	Bananas	do.
	or	Sugar Cane	do.

4. In addition to the above rations, 2 oz. of salt must be supplied per week and half-an-ounce of lemon juice daily or half a lemon on four days in each week, the juice of the lemon to be mingled with the food."

Helminthic Diseases.—The outstanding point of interest with regard to this group of diseases is the discovery of a case of infection with the Sparganum Mansoni. The case was under treatment at the Native Hospital, Nairobi, and approximated exactly to the case described by Baxter in what was formerly German East Africa in that the parasite was found in an abscess in the thigh of a Masai.

The high incidence of intestinal parasites in African natives has been commented on many times and it is probable that though no or very little inconvenience is caused to the host as long as he remains in his own country and surroundings, yet there is some reason to believe that it does not require much to upset the equilibrium and a change of food or climate and harder work may be enough to produce intestinal disorders in cases of helminthic infection.

It would appear that the effects of ankylostomiasis are more marked in the Coast Belt than in other parts.

EUROPEAN OFFICIALS.

During 1921 the total and average numbers of officials resident were higher than in the preceding year, but the sick time figures remain at about the same comparative level. There is a slight drop in the percentage of deaths and invalidings. The actual number of invalidings was less than in 1920 and the deaths remained at the same figure.

The comparative table as regards in-patients and out-patients is as follows :—

	In-patients.	Out-patients.
1921	603	676
1920	611	618
1919	776	810

The deaths were due to the following causes :—

Blackwater Fever	1 case
Diabetes	1 ,,
Appendicitis	1 ,,
Heart Failure	1 ,,

and in addition death occurred on the voyage home in a case of kala-azar after invaliding.

The causes of invaliding were :—Debility, 2 cases; kala-azar, 1 case; malaria, 1 case; tuberculosis, 2 cases; anæmia, 1 case; locomotor ataxia, 1 case; neurasthenia, 2 cases; bronchitis, 1 case; asthma, 1 case; dyspepsia, 1 case; hepatitis, 1 case; empyema of gall bladder, 1 case; appendicitis, 1 case.

Among the chief causes of admission were :—Malaria, influenza, diseases of the digestive system and local injuries.

TABLE SHOWING THE SICK, INVALIDING AND DEATH RATES AMONGST EUROPEAN OFFICIALS IN THE COLONY AND PROTECTORATE OF KENYA.

	1919.	1920.	1921.
Total number of officials resident	1,118	1,259	1,353
Average number resident	663	746	1,011
Total number on sick list	748	574	592
Total number of days on sick list	5,997	6,373	8,704
Average daily number on sick list	16·43	17·41	23·84
Percentage of sick to average number resident ...	2·47	2·33	2·35
Average number of days on sick list to each patient ...	8·01	11·12	14·70
Average sick time to each resident	5·36	5·39	6·43
Total number invalided	38	28	16
Percentage of invaliding to total residents	3·39	2·36	1·18
Total deaths	15	4	4
Percentage of deaths to total residents	1·34	·34	·29
Percentage of deaths to average number resident ...	2·26	·53	·39
Number of cases of sickness contracted away from residence	—	—	—

NON-EUROPEAN OFFICIALS.

It will be noted from the tables that in spite of an increased staff of non-European officials, the returns of sickness, invalidings and deaths show not only proportionate, but an actual decrease, and there is a drop of over 3,000 sick days.

The deaths amounted to 10, as against 12 in the preceding year, and the causes were :—Pneumonia, 3 cases; bronchitis, 2 cases; cirrhosis of liver, 1 case; blackwater fever, 3 cases; tuberculosis, 1 case.

The invalidings totalled 53, and were due to pneumonia, 1 case; tuberculosis, 1 case; anæmia, 1 case; debility, 7 cases; sciatica, 1 case; paralysis, 1 case; neurasthenia, 3 cases; mania, 4 cases; eye affections, 8 cases; æneurism, 1 case; asthma, 1 case; gastritis, 1 case; dyspepsia, 4 cases; prostatitis, 1 case; arthritis, 8 cases; ankylosis, 1 case; ametropia, 1 case; tachycardia, 1 case; hæmoptysis, 1 case; appendicitis, 1 case; hernia, 1 case; hæmorrhoids, 1 case; diabetes, 1 case; malaria, 2 cases.

The comparative table of in and out patients is as follows :—

	In-patients.	Out-patients.
1921	4,020	1,896
1920	4,486	2,261
1919	4,748	2,963

The most frequent causes of admission to hospital were :—Malaria, dysentery, influenza, diseases of digestive system and bronchitis.

TABLE SHOWING THE SICK, INVALIDING AND DEATH RATES AMONGST NON-EUROPEAN OFFICIALS IN THE COLONY AND PROTECTORATE OF KENYA.

	1919.	1920.	1921.
Total number of officials resident	2,252	2,392	2,429
Average number resident	1,717	1,762	1,987
Total number on sick list	4,703	4,439	3,951
Total number of days on sick list	33,159	30,053	22,865
Average daily number on sick list	90·84	82·11	62·64
Percentage of sick to average number resident	5·29	4·66	3·15
Average number of days on sick list to each patient ...	7·05	6·77	5·78
Average sick time to each resident	14·72	13·29	9·41
Total number invalided	62	60	53
Percentage of invaliding to total residents	2·75	2·65	2·18
Total deaths	15	12	10
Percentage of deaths to total residents	·66	·53	·41
Percentage of deaths to average number resident ...	·87	·68	·50
Number of cases of sickness contracted away from residence	—	—	—

GENERAL EUROPEAN POPULATION.

Owing to the increasing number of private practitioners, the figures are less and less a true reflection of the state of health of this section of the population.

The figures for the past three years are :—

	In-patients.	Out-patients.
1921	767	781
1920	875	541
1919	545	1,505

The largest number of cases appear under the headings :—Malaria, enteric fever and diseases of the digestive system.

The deaths totalled 31, and were due to the following causes :—Dysentery, 1 enteric, 5; plague, 2; pneumonia, 2; septicæmia, 1; tuberculosis, 1; cerebral hæmorrhage, 2; mental disease, 1; mastoiditis, 1; tonsillitis, 1; appendicitis, 3; diarrhœa, 1; suppression of urine, 1; ovarian cyst, 1; displacement of uterus, 1; peritonitis, 1; injuries, 2; dengue, 1; endocarditis, 2; enteritis, 1.

GENERAL NATIVE POPULATION.

The comparative table of cases treated for the past three years is as follows :—

	In-patients.	Out-patients.
1921	24,287	154,198
1920	16,404	107,480
1919	16,661	95,574

The very large increase in numbers is due, chiefly, to the increase of centres in Native Reserves and, in less degree, to the increased readiness with which this section of the population is availing itself of the older established institutions.

The comparative table of deaths and death rates of admissions to hospital as shown below makes gratifying reading, although, as has been previously remarked, the native still prefers to remain in his own surroundings when acutely ill :—

1921	809	33·3 per 1,000 in-patients.
1920	861	53·8 ,, ,, ,,
1919	1,203	75·0 ,, ,, ,,

3.—LUNATIC ASYLUM.

The following table gives the number of admissions and deaths during the last three years :—

	Admissions.			Deaths.		
	1921.	1920.	1919.	1921.	1920.	1919.
Males	70	78	78	21	22	22
Females	18	9	13	5	1	6
Total	88	87	91	26	23	28

Dr. J. H. Thomson was in medical charge from February till the end of the year.

During the year 160 patients were treated altogether.

Admissions.—The number admitted was 88—Males, 70; Females, 18.

The following table gives the places from which patients were admitted. Nairobi was responsible for 50 per cent. :—

Nairobi	44	Fort-Hall	2
Mombasa	15	Lamu	1
Kisumu	7	Meru	1
Kyambu	4	Voi	1
Nyeri	3	Embu	1
Eldoret	3	Thika	1
Eldama-Ravine	2	Uganda	1
Nakuru	2		

The varieties of insanitary for which patients were admitted were :—Mania, 37; dementia, 16; delusional insanity, 14; idiocy, 2; melancholia, 1; other mental diseases, including epileptic, G.P.I., etc., 18.

Deaths.—There were 26 deaths, including one European.

The percentage of deaths to total number treated was 16·2.

The percentage to admissions was 29·5.

Discharges.—48 patients were discharged during the year cured and 3 relieved.

The percentage ratio of discharges to admissions was 57·9. This is very high :—

1921.	1920.	1919.
51	70	48

Remaining.—There were 82 patients remaining on December 31st :—

1921.	1920.	1919.
82	78	63

EUROPEAN SECTION.

There were twenty cases treated during the year.

Admissions, 14—Males, 10; Females, 4.

The admissions were from the following places :—Nairobi, 10; Mombasa, 2; Eldoret, 2.

The nationalities of the admissions were :—English, 8; French, 1; South African, 1; Scotch, 1; South African Dutch, 1; Australian, 2.

Their condition as to marriage was :—Single, 6; Married, 8.

The great majority of the admissions was caused by alcohol. One of these cases was a case of alcoholic pseudo-general paralysis and another was a case of mania a potu super added on a very neurotic temperament. The majority of cases which come under notice are of toxic origin, but cases go out of the country especially when near the border line, so that any generalizing on the above statistics would be valueless.

Discharges.—Eight were discharged, of whom three left the country.

Deaths.—One male died. He was was suffering from *Delirium tremens* with pneumonia on admission. He was in an almost hopeless condition when admitted and died in two days.

Remaining.—Eight remained on December 31st and these are probably all incurable.

Their nationalities are :—English, 3; Scotch, 1; Irish, 1; Australian, 1; South African Dutch, 1; Greek, 1.

Their state as regards marriage is :—

Married, 4; single, 3; widow, 1.

They are suffering from :—Imbecility, 1; dementia, 2; chronic mania, 3; delusional insanity, 1; paranoia, 1.

Four are indigent and will probably have to be kept by the State until they die. Efforts were made to get one other case to England but his friends refused to have him at home.

General.—The new European block was opened in April. It is a good building, cool and airy and is very well adapted to its purpose, but there are a few defects.

The female European quarters consist of two rooms and a central hall, and these are too large for acute cases. The addition of single rooms is required and the existing quarters would then form very good living rooms.

The question of amusing and interesting the convalescent and chronic cases is very difficult. It has been possible to obtain magazines and illustrated weekly papers. The numbers of the patients are too few for associated outdoor games like cricket or football.

NATIVE SECTION.

57 were admitted—Males, 43. Females, 14.

The natives are mostly all admitted from settled European areas. There does not seem to be a great deal of insanity in the Reserves except that of a temporary acute kind, which is responsible for a good many of our criminal lunatics. The numbers admitted are about equivalent to an asylum population of about five hundred, but we discharge a great many and our death rate is fairly large, so that the total asylum population does not show a very large increasing residue. It is very difficult to state the cause of insanity, as no history of the cases is obtainable. The cases which come under observation before admission in Nairobi are usually found wandering and nothing is known about them. Probably alcohol may play a prominent part in the causation.

Discharges.—There were 39 discharged :—

37 cured; 2 relieved.

Deaths.—There were 25 deaths :—

Males, 20. Females, 5.

Most of the deaths occur in patients recently or comparatively recently admitted. Patients as a rule put on flesh and do well physically, but a certain number go down hill rapidly. One patient died of *status epilepticus.*

Sickness.—There are usually twelve or fourteen on the sick list, of whom some are infirm dements and others are epileptics in a state of confusion after a bout of fits. Inflammation of the eyes is common from patients rubbing earth, etc., into them.

An improvement which would be of great benefit would be the provision of an airy ward of about twelve beds where the sick and infirm males could be treated as purely hospital patients and entirely segregated from the other patients.

General.—Glass and gauze were taken out of the windows of the wards in both female and male blocks and ventilators put in the walls above the floor; this has effected a great improvement.

Criminals.—There were nine criminal cases remaining at the end of the year, of whom one is an European.

ASIATIC SECTION.

Admissions, 3.

One was caused by alcohol and another was a re-admission who had been taken out by his friends the year before.

Discharges.—Two :—One Indian; one Goan (to Goa) relieved.

Remaining.—Five :—Indians, 4 (including 1 female); Goan, 1.

Deaths.—Nil.

Shamba.—The shamba is useful as a means of providing work for the patients; but the soil is very bad, consisting of murrum and rock with patches of black cotton soil and is practically worked out by continual cropping.

The grounds of the Asylum are kept very well.

4.—GOVERNMENT DENTAL SURGERY, NAIROBI.

No additional appointments were made during the year in order to cope with the growing demand for dental treatment by Government officials.

During the year the following outstations were visited by the Government Dental Surgeon :—Kisumu, three times; Nakuru, three times; Mombasa twice; and the following stations once each : Eldoret, Fort-Hall, Embu, Meru, Nyeri. These visits to outstations, although a necessity, interfere with work in headquarters, in which place alone there is sufficient work to keep two surgeons consistantly busy.

It has not been possible to undertake dental treatment for the non-European officials, although it is probable that a large proportion of disabilities among this section may be attributable to oral sepsis.

I append a table showing the total treatments given to the European Staff :—

Table 1.

Number of officials treated (including families)	993
Number of appointments given	1,836
Treatment rendered :—	
Fillings (plastic)	1,371
,, (gold)	29
Extractions	368
Crowns (gold and porcelain)	63
Bridges	8
Roof fillings	235
Scalings, done in practically all cases.	
Dentures	69
Repairs to dentures	111

The number of officials arriving in the country on first appointment, who require immediate attention in order to render them dentally fit, shows little improvement.

It is of prime importance that all officers sent to this country should be dentally sound, as their general health and fitness for work is largely dependent thereon.

5.—GAOLS.

There is little of note to record in this section. As before, Nairobi gaol heads the list with regard to the sick and death rates, and the overcrowded condition of this institution continues.

Kisumu gaol again returned no deaths and Mombasa only one.

There has been no addition to the hospital accommodation at Nairobi and the sick still continue to be treated, in a large proportion of cases, in tents.

Pneumonia, as previously, continued the chief cause of death, and out of a total of 44 accounted for 32 cases.

The comparative table is as follows :—

	Mombasa.		Nairobi.		Kisumu.	
	1921.	1920.	1921.	1920.	1921.	1920.
Total number of prisoners on 1st January	300	287	746	767	107	140
Number admitted during the year ...	1,127	1.220	2,393	3,047	592	535
Average daily number in gaol ...	274	308	760	737	93	118
Total number placed on sick list ..	268	285	1,133	989	48	146
Total number of days on sick list ...	2,927	2,573	17,476	16,374	448	1,375
Average number sick daily	8·02	7·03	47·87	44·70	1·23	3·76
Total number of deaths	1	1	43	23	—	3
Percentage of deaths to average daily strength	·36	·32	5·65	3·12	—	2·54

RETURNS.

TABLE I.

ADMINISTRATIVE DIVISION.

Dr. J. L. Gilks	Principal Medical Officer.
Dr. C. L. Chevallier	Deputy Principal Medical Officer.
Dr. A. R. Paterson	Chief Sanitation Officer.
Mr. R. Stanley, M.B.E. ...	Office Superintendent.
Mr. D. S. Wardle	Accountant.
Mr. G. E. Scattergood	Clerk.
Mr. T. R. Wilson, D.C.M. ...	,,
(1) Mr. A. E. Webb	,,
Mr. J. S. Robertson, M.B.E. ...	Medical Storekeeper.

MEDICAL DIVISION.

Dr. F. L. Henderson	Senior Medical Officer.
Dr. G. R. H. Chell	,, ,, ,,
Dr. J. Pugh	,, ,, ,,
Dr. C. J. Wilson, M.C. ...	,, ,, ,,
Dr. N. P. Jewell, M.C. ...	,, ,, ,,
Dr. H. H. V. Welch	Resident Surgical Officer.
Dr. A. D. J. B. Williams, O.B.E.	Medical Officer.
Dr. T. F. Lumb	,, ,,
Dr. T. H. Massey, M.C. ...	,, ,,
Dr. P. F. Nunan	,, ,,
Dr. J. H. Thomson	,, ,,

TABLE I—*continued.*

MEDICAL DIVISION—*continued.*

	Dr. V. M. Fisher	Medical Officer.
	Dr. A. S. Mackie	,, ,,
	Dr. F. T. Auden	,, ,,
	Dr. R. C. Briscoe	,, ,,
(2)	Dr. M. C. Wetherell	,, ,,
	Dr. N. B. Peacock	,, ,,
	Dr. B. W. Dakers	,, ,,
	Dr. C. V. Braimbridge	,, ,,
	Dr. G. W. Pope	,, ,,
	Dr. F. J. C. Johnstone	,, ,,
	Dr. K. T. K. Wallington	,, ,,
	Dr. E. A. Davison	,, ,,
	Dr. J. O. Beven	,, ,,
	Dr. R. A. W. Procter, M.C.	,, ,,
	Dr. R. J. Harley-Mason	,, ,,
	Dr. J. C. J. Callanan	,, ,,
	Dr. C. H. Brennan, M.C.	,, ,,
	Dr. R. N. Hunter	,, ,,
	Dr. J. A. Ross	,, ,,
	Dr. W. H. Kauntze, M.B.E.	Bacteriologist.
	Dr. P. A. Clearkin	1st Assistant Bacteriologist.
	Dr. G. V. Allen	2nd Assistant Bacteriologist.
	Mr. F. A. Baily	Lab. Assistant.
	Dr. V. G. L. van Someren	Dental Surgeon.
	Dr. H. R. A. Philp	District Surgeon.
	Dr. C. J. Caddick	,, ,,
(3)	Dr. J. Forbes	,, ,,
(4)	Dr. G. Cross	,, ,,
	Mr. H. Ogden	Dispenser.
	Miss F. L. Neave	,,
	Mr. E. R. Edmonds	,,
	Mrs. E. R. Barrett	Matron.
	Miss H. M. Whitburn	Nursing Sister.
	Miss I. Wilson	,, ,,
	Mrs. S. J. Harrison	,, ,,
	Miss M. I. Rhind	,, ,,
	Miss A. B. Wharin	,, ,,
	Miss F. O'Neill	,, ,,
	Miss H. M. Friedricks	,, ,,
	Miss R. Anderson	,, ,,
	Miss P. S. Joubert	,, ,,
	Miss A. G. Leary	,, ,,
	Miss V. B. Painter	,, ,,
	Miss A. L. Stuart	,, ,,
	Miss E. B. Wishart	,, ,,
	Miss H. Masters	,, ,,
	Miss E. M. Froneman	,, ,,
	Miss M. Edwards	,, ,,
	Miss H. Hayward	,, ,,
(5)	Miss J. D. Murdoch	,, ,,
	Miss I. Cameron	,, ,,
	Miss M. Aitken	,, ,,
	Miss M. B. Munro	,, ,,
	Miss G. M. Buckley	,, ,,

TABLE I—*continued.*

MEDICAL DIVISION—*continued.*

Miss D. M. Kenny	Nursing Sister.
Miss F. M. Biggar	" "
Mr. W. Henfrey	Superintendent, Lunatic Asylum.
Mrs. L. A. Henfrey	Matron, Lunatic Asylum.
Miss E. Hamilton	Assistant Matron, Lunatic Asylum.
Mr. S. J. Bosch	Warder, Lunatic Asylum.
Mr. F. J. B. Jordan	Warder, Lunatic Asylum.

SANITATION DIVISION.

Dr. G. Walker	Medical Officer of Health.
Dr. E. W. N. Guinness ...	" "
Dr. H. S. de Boer	" "
Mr. A. F. Dennett	Sanitary Inspector.
Mr. B. E. F. Wetkin	" "
Mr. E. E. Williams	" "
Mr. F. Strawbridge	" "
Mr. P. Cairns	" "
Mr. J. P. Cook	" "
Mr. E. Holness, M.M.	" "
Mr. R. C. Mills	" "
Mr. F. R. Creighton	" "
Mr. A. P. Ling	" "
Mr. H. E. Taylor	" "
Mr. A. Bunker	" "
Mr. C. F. Bickell, M.M. ...	" "
Mr. D. P. Broad	" "
Miss M. A. Perkin	Nurse.
Miss R. K. Sharp	"
Mr. W. J. Edwards	Supt. Infectious Diseases Hospital.

REMARKS.

(1)—Transferred to Land Department, 15.11.21.

(2)—Agreement expired, 19.12.21.

(3)—Resigned, 31.10.21.

(4)—Resigned, 31.5.21.

(5)—Resigned, 6.8.21.

TABLE II.

FINANCIAL.

The sanctioned Medical Budget for 9 months of the year 1921 was a total of £189,438, as compared with £184,409 for the preceding 12 months.

TABLE II—*continued.*

Of the 1921 grand total £146,296 was expended, leaving an unexpended sum of £43,142.

The savings were chiefly due to buildings for three Government Medical Units, Mombasa Conservancy requirements and savings on appointments not filled.

The unexpended balances under "Special Expenditure" have been revoted to meet expenditure during next year under the same headings.

The headings under which the vote was arranged were as follows :—

SCHEDULE XIV.—MEDICAL DEPARTMENTS.

	Estimates. £	Actual Expenditure. £
ADMINISTRATIVE DIVISION.		
Personal Emoluments	10,733	8,651
(Under this heading are included the salaries of the Principal Medical Officer, Deputy Principal Medical Officer, Chief Sanitation Officer, Office Superintendent, Medical Storekeeper, Accountant, Clerical Establishment, Messengers and Packers.)		
MEDICAL DIVISION.		
Personal Emoluments	58,977	48,572
(Under this heading are included the salaries of the Senior Medical Officers, Resident Surgical Officer, Dental Surgeon, Medical Officers, Dispensers, Nurses, Superintendent, Warders, Matron and Assistant Matron Lunatic Asylum, Assistant Surgeons, Sub-Assistant Surgeons, Hospital Compounders, Native Hospital Attendants and Lunatic Asylum Attendants.)		
SANITATION DIVISION.		
Personal Emoluments	23,546	11,586
(Under this heading are included the salaries and duty allowances of the Medical Officers of Health, Sanitary Inspectors, Nurses, Vaccinators, Native Attendants for Infectious Diseases Hospitals, Leper Lazaretto and Quarantine Stations, Clerical Establishment, Mechanics for Clayton disinfectors, office and gharri boys.)		
LABORATORY DIVISION.		
Personal Emoluments	3,955	4,283
(Under this heading are included the salaries of the Senior and Assistant Bacteriologists, European and Asiatic Laboratory Assistants, Native Attendants and fees to Bacteriologists.)		

TABLE II—*continued.*

MEDICAL DEPARTMENTS.

	Estimates. £	Actual Expenditure. £
Other Charges	53,939	49,844
(Under this heading are included Medical and Surgical Stores, Contingencies, Transport, Up-keep of Hospitals, Uniforms, Furniture and Equipment, Electric Lighting, Water Supplies, Epidemics, Bush Clearing, Ambulance and Motor Services, etc., Medical Mission Units and Medical Work in Native Reserves.)		
Special Expenditure	38,288	23,360
(Purchase of disinfectors and buildings for 3 Medical Units in Native Reserves, Contribution to Nakuru War Memorial Hospital, Contribution to War Office for purchase of salvage stores, Furniture and Equipment for new hospitals, Conservancy requirements, Mombasa.)		

REVENUE.

The total amount of revenue collected as hospital fees, sales of medicines and surgical stores, bills of health and registration fees was as follows :—

	£	s.	cts.
Hospital fees and sales of medicines ...	5,151	0	00
Bills of Health	407	0	00
Registration Fees	41	5	00
Total	£5,599	5	00

Last year the total revenue collected amounted to £6,709 8s. 22cts.

TABLE III.

RETURN OF STATISTICS OF POPULATION FOR THE YEAR 1921.

KENYA COLONY AND PROTECTORATE.	Europeans and Whites.	Africans and Others.	Asiatics.
Number of Inhabitants in 1921	9,651	3,000,000*	25,880
Number of Births registered in 1921	255	†	†
Number of Deaths registered in 1921	90	†	†
Number of Immigrants during 1921	4,298	2,189	5,539
Number of Emigrants during 1921	(Figures not obtainable.)		
Number of Inhabitants during 1920	8,000*	3,000,000*	25,000*

* Approximately. † Not registered.

TABLE IV.

1.—SUMMARY OF ROUTINE SANITARY WORK DONE DURING THE YEAR IN THE TOWN OF NAIROBI.

For the Year ending 31st December, 1921.

	Approximate Area.	Number of proclaimed Open Spaces.
1919	7 sq. miles ...	Public Park. Jeevanjee Garden. Arboretum. Municipal Forest. Show Ground, Parklands.
1920		
1921		

2.—POPULATION.

	Number of Natives.		Number of Europeans.		Total Approx.
	Males.	Females.	Males.	Females.	
1919	No estimates possible.				
1920	12,343	(estimated)	1,348	976	22,700
			Children.		
1921			276	329	24,377

3.—HOUSING.

	Number occupied by Europeans.	Number occupied by Natives and Asiatics.
Number of Houses :—		
1919	662	417 Asiatics only.
1920	695	459 do.
1921	743	592 do.

Number of Huts :—

1919	1,450	approximately.
1920	1,463	do.
1921	1,442	do.

4.—MOSQUITO PROTECTION OF HOUSES.

	1919.	1920.	1921.
Number of European houses wholly mosquito-protected ...	*Nil*	*Nil*	*Nil*
Number of European houses with mosquito room			
Number rendered during the year wholly mosquito-protected			
Number rendered during the year partially mosquito-protected			

TABLE IV—*continued.*

5.—ERECTION OF NEW BUILDINGS DURING THE YEAR.

	1919.	1920.	1921.
Number of public buildings erected with sanction as to site, construction, and relation to other buildings	...	3	2
Number of houses erected with sanction as to site, construction, and relation to other buildings	49	71	83
Number of huts erected with sanction as to site, construction, and relation to other buildings	...	2	3
Number of houses built without sanction	...	1	...
Number of huts built without sanction	...	4	1

ACTION TAKEN.

	Number of Prosecutions.		Number Demolished.	
	Huts.	Houses.	Huts.	Houses.
1919	...	...	...	..
1920	4	1	3	...
1921	1	...	1	...

6.—MARKETS.

	Total number.	Number paved and drained.	Number unpaved.
1919	2	1 paved 1 undrained	1
1920	2	1 paved 1 undrained	1
1921	2	1 paved 1 undrained	1

7.—SLAUGHTER-HOUSES.

	Total number.	Number paved and drained.	Number unpaved.
1919 ... 1920 ...	2	2	*Nil*
1921	2	2	...
	(one at M'bagathi	Township)	

TABLE IV—*continued.*

8.—LATRINES.

	For Males.		For Females.	
	Number.	Number of Seats.	Number.	Number of Seats.
Number of public latrines :—			Europeans.	
1919...	24	200	...	...
1920...	24	200	...	...
1921...	24	200	...	...
Number of new public latrines erected during the year :—				
1919...	...	...	...	...
1920...	...	...	...	...
1921...	...	...	...	...
Number of public latrines repaired during the year :—				
1919...	3	24	...	...
1920...	2	...	...	...
1921...	1	...	...	...
Number of public latrines demolished during the year :—				
1919...	2	12	...	...
1920...	...	...	...	...
1921...	...	...	...	...

	1919.	1920.	1921.
Number of private latrines	2,263	2,477	2,538
Average number of pails of nightsoil daily removed	2,436	2,834	2,942
Average number of soiled pails removed and clean pails substituted	...	...	...
Number of nightsoil men employed to clean latrines and to remove excrete	99	122	104
Number of cesspools	1	1	1
Number of cesspools cleaned	1	1	1
Number of new cesspools constructed during the year ...	...	...	...
Number of old cesspools abolished	...	...	...
Number of cesspools oiled regularly by Department	...	...	...

9.—REMOVAL OF REFUSE.

	1919.	1920.	1921.
Number of dustbins	1,282	1,593	1,614
Number of carts at work daily to remove refuse from streets	15	27	33
Amount of refuse removed daily	24	90	104
Number of carts at work daily to remove refuse from yards and premises	22	26	29
Amount of refuse removed daily from yards and premises ...	45	10	15
Number of men employed for removing refuse	95	56	64

TABLE IV—*continued.*

10.—MODE OF DISPOSAL OF EXCRETA, REFUSE AND OFFAL.

	Daily average number of pails of excreta.			Daily average number of cartloads of refuse.			Daily average number of cartloads of slaughter-house and market offal.		
	1919.	1920.	1921.	1919.	1920.	1921.	1919.	1920.	1921.
Buried or trenched	2,436	2,834	2,942	...	...	...	2	3	3
Burnt	...	...	...	...	90	104	1	2	3
Thrown into sea	...	...	...	...	...	...	...	...	...
Otherwise dealt with	...	...	...	...	...	...	...	...	...

11.—AVERAGE DAILY NUMBER OF CARTLOADS OF CANS, BOTTLES, BROKEN CROCKERY AND OTHER INCOMBUSTIBLE MATERIAL REMOVED FROM HOUSES, HUTS AND COMPOUNDS.

	1919.	1920.	1921.
Cartloads	22	25	31

12.—WATER SUPPLY.

Nature of Water Supply.	1919	1920.	1921.
Pipe-borne water :—			
Source (river, lake or spring)—		Springs.	
Number of linear yards	520,773	528,249	532,794
Number of standpipes along roads	...	...	...
Number of standpipes in compounds and houses ...	1,208	1,207	1,310
Wells :—			
Public—			
Number	...	...	...
Number with pumps protected against surface water and mosquito-protected	...	...	...
Private—			
Number	...	...	...
Number with pumps protected against surface water and mosquito-protected	...	...	...
Tanks :—			
Public—			
Number under ground	*Nil*	*Nil*	*Nil*
Number mosquito-protected and served by pumps ...			
Number above ground			
Number mosquito-protected			
Number of 400 gallons capacity or less			
Number above 400 gallons			
Private—			
Number under ground	...	...	...
Number mosquito-protected	...	...	...
Number above ground...	155	155	...
Number mosquito-protected	155	155	...
Number of 400 gallons capacity or less	43	43	...
Number above 400 gallons	112	112	...
Nature of tanks :—			
Wood	...	...	...
Iron	155	155	...
Concrete	...	...	...
Barrels :—			
Number	150	150	...
Number mosquito-protected	140	140	...

TABLE IV—*continued.*

13.—DRAINAGE.

	Public.	Private.
Masonry Drains—		
Linear yards of masonry drains—		
1919	37,074	No information
1920	40,009	"
1921	40,009	"
Linear yards reconstructed during the year—		
1919	...	"
1920	...	"
1921	...	"
Linear yards repaired during the year—		
1919	64	"
1920	175	"
1921	...	"
Linear yards of new drains constructed during the year—		
1919	577	"
1920	3,535	"
1921	...	"
Earth Drains or Ditches cleansed—		
Number of linear yards of ditches cleansed—		
1919	200,689	"
1920	354,457	"
1921	...	"
Number of linear yards of ditches dug and graded—		
1919	200,689	"
1920	300,584	"
1921	...	"
Average frequency of clearing ditches of grass—		
1919	When necessary	"
1920		"
1921		"

14.—CLEARANCE OF UNDERGROWTH, LONG GRASS AND JUNGLE.

	1919.	1920.	1921.
Number of square yards of weeds, grass and vegetation cut and removed	3,296,040	...	...
Average frequency of clearance of rank vegetation on same area	Where necessary	Where necessary	Where necessary

15.—EXCAVATIONS OF LOW-LYING LAND.

	1919.	1920.	1921.
Number of pools and excavations	30	...	...
Number of excavations filled up	98	80	...
Amount of low-lying and marsh land raised and drained	...	...	...
Number of pools, marshes, etc., fish-stocked ...	...	...	...
Number of cubic yards of material used for filling up pools and excavations	...	...	...
Number of persons fined for making new excavations	...	...	...
Average number of men daily employed in filling up pools, etc.	20	20	...

TABLE IV—*continued.*

16.—OILING.

	1919.	1920.	1921.
Number of drains oiled	...	...	...
Number of pools and excavations oiled	633	700	...
Number of tanks and barrels oiled	1,270	3,000	...
Average number of men daily employed for oiling drains, pools and water-tanks or barrels	12	3	...

17.—INSPECTIONS AND PROSECUTIONS.

	1919.	1920.	1921.
Number of Inspectors employed	3	3	3 for 8 months 5 ,, 4 ,,
Number of premises inspected	6,700	5,416	...
Number of houses where larvæ were found	778	642	...
Number of notices and reminders served to remove conditions causing the breeding of larvæ	814	230	...
Number of persons fined for having mosquito larvæ on premises	1	...	...
Number of notices and reminders served to remove insanitary conditions on premises	552	534	...
Number of persons fined for not removing insanitary conditions after notice	...	3	...
Number of soda and ærated water factories inspected	5	7	4 inspected weekly

TABLE IV.

1.—SUMMARY OF ROUTINE SANITARY WORK DONE DURING THE YEAR IN THE TOWN OF MOMBASA.

For the Year ending 31st December, 1921.

	Approximate Area.	Number of proclaimed Open Spaces.
1919 1920	Island, 8¾ square miles Town of Mombasa, 270 acres	1 public garden.
1921	...	...

2.—POPULATION.

	Number of Natives.		Number of Europeans.		Total Approx.
	Males.	Females.	Males.	Females	
1919	12,620	9,549	191	90	30,039
	Children, 7,527		Children, 55		
1920	12,941	7,686	300	100	26,018
	Children, 4,911		Children, 80		
1921	12,957	9,945	383	175	32,236
	Children, 8,681		Children, 95		

TABLE IV—*continued.*

3.—HOUSING.

	Number occupied by Europeans.	Number occupied by Natives and Asiatics.
Number of Houses :—		
1919	110	3,760 huts. 1,006 stone houses.
1920	170	3,868 huts. 1,036 stone houses.
1921	190	3,917 huts. 1,040 stone houses.

Number of huts :—

1919	3,868
1920	3,917
1921	—

4.—MOSQUITO PROTECTION OF HOUSES.

	1919.	1920.	1921.
Number of European houses wholly mosquito-protected ...	...	...	...
Number of European houses with mosquito room	2	...	...
Number rendered during the year wholly mosquito-protected	...	...	...
Number rendered during the year partially mosquito-protected	2	...	...

5.—ERECTION OF NEW BUILDINGS DURING THE YEAR.

	1919.	1920.	1921.
Number of public buildings erected with sanction as to site, construction, and relation to other buildings	...	1	1
Number of houses erected with sanction as to site, construction, and relation to other buildings	48	53	...
Number of huts erected with sanction as to site, construction, and relation to other buildings and reconstructed ...	110	49	...
Number of houses built without sanction	2	1	...
Number of huts built without sanction	...	...	...

ACTION TAKEN.

	Number of Prosecutions.		Number Demolished.	
	Huts.	Houses.	Huts.	Houses.
1919	...	2	1	2 altered to conform to plan.
1920	...	4	150 buildings altered to conform to plan.	...
1921	...	...	...	30 demolished or altered under notice.

TABLE IV—*continued.*

6.—MARKETS.

	Total number.	Number paved and drained.	Number unpaved.
1919	3	2	1
1920	3	2	1
1921	3	2	1

7.—SLAUGHTER-HOUSES.

	Total number.	Number paved and drained.	Number unpaved.
1919...	1	1	*Nil*
1920...	1	1	*Nil*
1921...	1	1	*Nil*

8.—LATRINES.

	For Males.		For Females.	
	Number.	Number of Seats.	Number.	Number of Seats.
Number of public latrines :—				
1919	7	17	...	...
1920	9	33	...	...
1921	7	28	...	...
Number of new public latrines erected during the year :—				
1919	1	2	...	...
1920	3	24	...	...
1921	4	4	...	...
Number of public latrines repaired during the year :—				
1919	...	...	...	...
1920	...	...	...	...
1921	...	...	...	...
Number of public latrines demolished during the year :—				
1919	1	...	...	...
1920	3 choos	...	...	...
1921	5 & 1 choo	5–4	...	...

	1919.	1920.	1921.
Number of private latrines	...	...	242
Government Offices	...	...	129
Average number of pails of night-soil daily removed, including public latrines	255	331	399
Average number of soiled pails removed and clean pails substituted	...	28	28
Number of night-soil men employed to clean latrines and to remove excreta	29	56	44 18
Number of cesspools	...	Thousands	
Number of cesspools cleaned	70	70	70
Number of new sullage cesspools constructed during the year	26	85	76
Number of old cesspools abolished	9	41	39
Number of cesspools oiled regularly by Department	1,378	1,077	2,626

TABLE IV—*continued.*

9.—REMOVAL OF REFUSE.

	1919.	1920.	1921.
Number of dustbins	1,006	63 public 1,500 private	66 public 1,500 private
Number of carts at work daily to remove refuse from streets	16	23 carts 1 mot'rlorry	20 1 mot'rlorry
Amount of refuse removed daily, tons	17	56 loads	57
Number of carts at work daily to remove refuse from yards and premises	1	2	2
Amount of refuse removed daily from yards and premises ...	1 ton	4 loads	3 tons
Number of men employed for removing refuse	167	227	236

10.—MODE OF DISPOSAL OF EXCRETA, REFUSE AND OFFAL.

	Daily average number of Pails of Excreta.			Daily average number of Cartloads of Refuse.			Daily average number of Cartloads of Slaughter-house and Market Offal.		
	1919.	1920.	1921.	1919.	1920.	1921.	1919.	1920.	1921.
Buried or trenched ...	...	...	...	...	...	...	...	...	...
Burnt	...	...	...	...	42	...	...	...	...
Thrown into sea ...	180	331	399	42	...	57	230	...	$\frac{1}{4}$
Otherwise dealt with ...	...	...	...	...	...	...	...	...	...

11.—AVERAGE DAILY NUMBER OF CARTLOADS OF CANS, BOTTLES, BROKEN CROCKERY AND OTHER INCOMBUSTIBLE MATERIAL REMOVED FROM HOUSES, HUTS AND COMPOUNDS.

1919.	1920.	1921.
4	4	6

TABLE IV—*continued.*

12.—WATER SUPPLY.

Nature of Water Supply.	1919.	1920.	1921.
Pipe-borne water—			
Source (river, lake, or spring)—	River.	River.	
Number of linear yards	10,740	11,740	17,948
Number of stand-pipes along roads	20	1	13
Number of stand-pipes in compounds and houses ...	100	125	266
Wells :—			
Public—			
Number	28	28	28
Number with pumps protected against surface water and mosquito-protected	...	...	...
Private—			
Number	83	81	61
Number with pumps protected against surface water and mosquito-protected	...	...	...
Tanks :—			
Public—			
Number underground	...	...	...
Number mosquito-protected and served by pumps ...	...	...	...
Number above ground	2	...	...
Number mosquito-protected	2	...	...
Number of 400 gallons capacity or less	...	...	...
Number above 400 gallons	2	...	...
Private—			
Number underground	82	82	82
Number mosquito-protected	82	82	82
Number above ground	...	...	...
Number mosquito-protected	...	...	...
Number of 400 gallons capacity or less	...	...	...
Number above 400 gallons	...	...	...
Nature of Tanks :—			
Wood	...	...	...
Iron	Unknown.	Unknown.	Unknown.
Concrete	82	82	82
Barrels :—			
Number	Unknown.	Unknown.	Unknown.
Number mosquito-protected	All licensed premises.	All licensed premises.	All licensed premises.

TABLE IV—*continued.*

13.—DRAINAGE.

	Public.	Private.
Masonry Drains :—		
Linear yards of masonry drains :—		
1919	...	...
1920	...	300 approx.
1921	...	300 ,,
Linear yards reconstructed during the year :—		
1919	...	...
1920	...	...
1921	...	...
Linear yards repaired during the year :—		
1919	...	Where necessary.
1920	...	
1921	...	
Linear yards of new drains constructed during the year :—		
1919	...	...
1920	...	1,500
1921	...	...
Earth drains or ditches cleansed—Number of linear yards of ditches cleansed :—		
1919	Where necessary.	
1920		
1921		
Number of linear yards of ditches dug and graded :—		
1919	...	...
1920	1,310	...
1921	...	...
Average frequency of clearing ditches of grass :—		
1919	Where necessary.	
1920		
1921		

14.—CLEARANCE OF UNDERGROWTH, LONG GRASS AND JUNGLE.

	1919.	1920.	1921.
Number of square yards of weeds, grass and vegetation cut and removed	785½	1,017 acres	1,151 acres
Average frequency of clearance of rank vegetation on same area	Frequently depends on rainfall.		

TABLE IV—*continued.*

15.—EXCAVATIONS OF LOW-LYING LAND.

	1919.	1920.	1921.
Number of pools and excavations	...	...	...
Number of excavations filled up	31	35	17
Amount of low-lying and marsh land raised and drained ...	*Nil.*	1 acre nr. Salim Rd.	...
Number of pools, marshes, etc., fish-stocked	13	...	...
Number of cubic yards of material used for filling up pools and excavations	171	170 approx.	100 approx.
Number of persons fined for making new excavations ...	Casual.	Casual.	Casual.
Average number of men daily employed in filling up pools, etc.	...	...	...

16.—OILING.

	1919.	1920.	1921.
Number of drains oiled	300	300	*Nil.*
Soakaways and wells	130	130	142
Number of pools and excavations oiled	8	19	12
Number of tanks and barrels oiled, emptied or otherwise destroyed	274	211	1,299
Average number of men daily employed for oiling drains, pools, and water tanks or barrels	6	7	5

17.—INSPECTIONS AND PROSECUTIONS.

	1919.	1920.	1921.
Number of European Sanitary Inspectors employed ...	3	3	2
Number of houses inspected	12,781	23,311	9,011
Number of houses where larvæ were found	180	238	548
Number of notices served to remove conditions causing the breeding of larvæ	531	320	662
Number of persons fined for having mosquito larvæ on premises	5	4	30
Number of notices served to remove insanitary conditions on premises	2,171	1,042	644
Number of persons fined for not removing insanitary conditions after notice	16	12	15
Number of soda and ærated water factories inspected	4	4	4

TABLE IV.

1.—SUMMARY OF ROUTINE SANITARY WORK DONE DURING THE YEAR IN THE TOWN OF KISUMU (NYANZA PROV.)

For the Year ending 31st December, 1921.

	Approximate Area.	Number of proclaimed Open Spaces.
1919	19·6 sq. miles	1
1920	19·6 sq. miles	1
1921	19·6 sq. miles	1

2.—POPULATION.

	Number of Natives.		Number of Europeans.		Total approx.
	Males.	Females.	Males.	Females.	
1919 ...	Natives 3,600 Asiatics 800	Natives 2,000 Asiatics 300	100	50	6,850
1920 ...	Natives 4,320 Asiatics 960	Natives 2,200 Asiatics 360	150	60	8,050
1921 ...	Natives 2,945 Asiatics 901	Natives 998 Asiatics 301	96	48	5,289

TABLE IV—*continued.*

3.—HOUSING.

	Number occupied by Europeans.	Number occupied by Natives and Asiatics.
Number of Houses :—		
1919	57	149
1920	57	150
1921	57	152

Number of Huts :—	
1919	1,220
1920	1,230
1921	1,240

4.—MOSQUITO PROTECTION OF HOUSES.

	1919.	1920.	1921.
Number of European houses wholly mosquito-protected ...	19	20	20
Number of European houses with mosquito room	52	53	53
Number rendered during the year wholly mosquito-protected...	*Nil*	1	*Nil*
Number rendered during the year partially mosquito-protected	*Nil*	1	*Nil*

5.—ERECTION OF NEW BUILDINGS DURING THE YEAR.

	1919.	1920.	1921.
Number of public buildings erected with sanction as to site, construction, and relation to other buildings	*Nil*	3	*Nil*
Number of houses and shops erected with sanction as to site, construction, and relation to other buildings	5	2	2
Number of huts erected with sanction as to site, construction, and relation to other buildings	20	20	10
Number of houses built without sanction	*Nil*	*Nil*	*Nil*
Number of huts built without sanction	*Nil*	*Nil*	3

ACTION TAKEN.

	Number of Prosecutions.		Number Demolished.	
	Huts.	Houses.	Huts.	Houses.
1919	...	1	23	*Nil*
1920	...	3	50	*Nil*
1921	...	...	...	...

6.—MARKETS.

	Total number.	Number partly paved and drained.	Number unpaved.
1919	1	1	*Nil*
1920	1	1	*Nil*
1921	1	1	*Nil*

TABLE IV—*continued.*

7.—SLAUGHTER-HOUSES.

	Total number.	Number paved and drained.	Number unpaved.
1919	2	2	*Nil*
1920	2	2	*Nil*
1921	2	2	*Nil*

8.—LATRINES.

	For Males.		For Females.	
	Number.	Number of Seats.	Number.	Number of Seats.
Number of public latrines :—				
1919...	15	113	...	...
1920...	15	101	...	...
1921...	15	101	...	...
Number of new public latrines erected during the year :—				
1919...	*Nil*	*Nil*	...	...
1920...	2	12	...	...
1921...	1	6	...	...
Number of public latrines repaired during the year :—				
1919...	2	...	...	...
1920...	2	24	...	...
1921...	1	...	...	...
Number of public latrines demolished during the year :—				
1919...	1	10	...	...
1920...	2	24	...	...
1921...	1	...	...	...

	1919.	1920.	1921.
Number of private latrines	315	320	325
Average number of pails of nightsoil daily removed	679	683	688
Average number of soiled pails removed and clean pails substituted...	*Nil*	*Nil*	*Nil*
Number of nightsoil men employed to clean latrines and to remove excreta	45	45	45
Number of cesspools (concrete)	139	146	148
Number of cesspools cleaned	7	7	...
	Above cleaned daily.		
Number of new cesspools constructed during the year ...	7	7	2
Number of old cesspools abolished	*Nil*	1	*Nil*
Number of cesspools oiled regularly by Department	*Nil*	*Nil*	*Nil*

9.—REMOVAL OF REFUSE.

	1919.	1920.	1921.
Number of dustbins	400	400	410
Number of carts at work daily to remove refuse from streets	4	4	4
			cart-loads.
Amount of refuse removed daily	40	40	39
Number of carts at work daily to remove refuse from yards and premises	10	10	11
Amount of refuse removed daily from yards and premises ...	36	36	27
Number of men employed for removing refuse	34	34	34

TABLE IV—*continued.*

10.—MODE OF DISPOSAL OF EXCRETA, REFUSE AND OFFAL.

	Daily average number of pails of excreta.			Daily average number of cartloads of refuse.			Daily average number of cartloads of slaughter-house and market offal.		
	1919.	1920.	1921.	1919.	1920.	1921.	1919.	1920.	1921.
Buried or trenched	679	679	688	22	22	*Nil*	1	1	1
Burnt	*Nil*	*Nil*	*Nil*	...	9	27	*Nil*	*Nil*	*Nil*
Thrown into sea	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
Otherwise dealt with	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	12	*Nil*	*Nil*	*Nil*

11.—AVERAGE DAILY NUMBER OF CARTLOADS OF CANS, BOTTLES, BROKEN CROCKERY AND OTHER INCOMBUSTIBLE MATERIAL REMOVED FROM HOUSES, HUTS AND COMPOUNDS.

1919.	1920.	1921.
3	3	3

12.—WATER SUPPLY.

Nature of Water Supply.	1919.	1920.	1921.
Pipe-borne water:—			
Source (river, lake or spring)—	Lake	Lake	Lake
Number of linear yards	12,600	12,600	15,890
Number of standpipes along roads	11	11	14
Number of standpipes in compounds and houses ...	82	82	85
Wells:—			
Public—			
Number	*Nil*	*Nil*	*Nil*
Number with pumps protected against surface water and mosquito-protected			
Private—			
Number			
Number with pumps protected against surface water and mosquito-protected			
Tanks:—			
Public—			
Number under ground	*Nil*	*Nil*	*Nil*
Number mosquito-protected and served by pumps ...			
Number above ground			
Number mosquito-protected			
Number of 400 gallons capacity or less			
Number above 400 gallons			
Private—			
Number under ground	*Nil*	*Nil*	*Nil*
Number mosquito-protected			
Number above ground	195	195	195
Number mosquito-protected	...	...	...
Number of 400 gallons capacity or less	64	64	64
Number above 400 gallons	131	131	131
Nature of Tanks:—			
Wood	*Nil*	*Nil*	*Nil*
Iron	81	81	81
Concrete	114	114	114
Barrels:—			
Number	*Nil*	*Nil*	*Nil*
Number mosquito-protected			

TABLE IV—*continued.*

13.—DRAINAGE.

	Public.	Private.
Masonry Drains :—		
Linear yards of masonry drains—		
1919	*Nil*	*Nil*
1920	110	*Nil*
1921	110	*Nil*
Linear yards reconstructed during the year—		
1919	1,916	*Nil*
1920	*Nil*	*Nil*
1921	*Nil*	*Nil*
Linear yards repaired during the year—		
1919	500	*Nil*
1920	70	*Nil*
1921	*Nil*	*Nil*
Linear yards of new drains constructed during the year—		
1919	4,726	*Nil*
1920	20	*Nil*
1921	*Nil*	*Nil*
Earth drains or ditches cleansed :—		
Number of linear yards of ditches cleansed—		
1919	40,000	*Nil*
1920	40,000	*Nil*
1921	20,000	*Nil*
Number of linear yards of ditches dug and graded—		
1919	1,986	*Nil*
1920	3,600	*Nil*
1921	*Nil*	*Nil*
Average frequency of clearing ditches of grass—		
1919	Monthly	Monthly
1920	"	"
1921	"	"

14.—CLEARANCE OF UNDERGROWTH, LONG GRASS AND JUNGLE.

	1919.	1920.	1921.
Number of square yards of weeds, grass and vegetation cut and removed	90,000	90,000	90,000
Average frequency of clearance of rank vegetation on same area	Quarterly	Quarterly	When necessary

15.—EXCAVATIONS OF LOW-LYING LAND.

	1919.	1920.	1921.
Number of pools and excavations	*Nil*	*Nil*	Numerous
Number of excavations filled up...	*Nil*	*Nil*	50 approx.
Amount of low-lying and marsh land raised and drained ...	*Nil*	*Nil*	approx. 40,000 sq. yds.
Number of pools, marshes, etc., fish-stocked	*Nil*	*Nil*	*Nil*
Number of cubic yards of material used for filling up pools and excavations.	*Nil*	*Nil*	approx. 22,000 cu. feet.
Number of persons fined for making new excavations... ...	*Nil*	*Nil*	*Nil*
Average number of men daily employed in filling up pools, etc.	*Nil*	*Nil*	20

TABLE IV—*continued.*

16.—OILING.

	1919.	1920.	1921.
Number of drains oiled	*Nil*	2	Drain oiled when necessary.
Number of pools and excavations oiled	*Nil*	3	As above.
Number of tanks and barrels oiled	*Nil*	*Nil*	*Nil*
Average number of men daily employed for oiling drains, pools and water-tanks or barrels	*Nil*	2 (when required.)	3

17.—INSPECTIONS AND PROSECUTIONS.

	1919.	1920.	1921.
Number of Inspectors employed...	1	1	1
Number of houses inspected	9,824	3,367	6,300
Number of houses where larvæ were found	*Nil*	1	1
Number of notices served to remove conditions causing the breeding of larvæ	7	3	6
Number of persons fined for having mosquito larvæ on premises	*Nil*	1	*Nil*
Number of notices served to remove insanitary conditions on premises	183	123	167
Number of persons fined for not removing insanitary conditions after notice	15	3	3
Number of soda and aerated water factories inspected	1	1	1

V.—METEOROLOGY.

The Department of Agriculture compiles statistics concerning rainfall and temperature at various places in the Colony and has furnished the figures given in the tables embodied in this report.

No other data can be given.

TABLES SHOWING MEAN ANNUAL RAINFALL AT VARIOUS POINTS IN THE DIFFERENT AREAS FOR THE YEAR 1921.

Coast Area.

Malindi	33·05
Mombasa	39·15
Mazeras	34·40
Mackinnon Road	10·56
Voi	7·24

Mountainous Area.

Masongelini	5·00
Makindu	36·67
Kiu	9·62
Athi River	6·75
Nairobi Laboratory	21·12
Kabete Farm	21·83

MOUNTAINOUS AREA—*continued.*

Naivasha	23·19
Nakuru	24·62
Molo	48·40
Eldama-Ravine	38·32

NYANZA AND KENYA PROVINCE.

Lumbwa	32·67
Muhoroni	48·37
Kisumu	39·86
Mumias (Kakamega)	64·06
Kericho	53·72
Nandi	41·81
Fort-Hall	27·83
Nyeri	26·08
West Kenya	19·43

DESERT AREA.

Kismayu	Not available.
Gosha Alexandra	
M'fudu	

Temperature and rainfall tables for Mombasa, Kabete Farm, Kisumu and Fort-Hall are inserted in Table V of the returns.

TABLE V.

METEOROLOGICAL RETURN FOR THE YEAR 1921.

KABETE FARM, NAIROBI.

MONTH.	TEMPERATURE.						RAINFALL.		WINDS.		REMARKS.
	Solar Maximum.	Maximum on Grass.	Shade Maximum.	Shade Minimum.	Range.	Max. and Min. Mean combined.	Amount in inches.	Degree of Humidity. %	General Direction.	Average Force.	
January ...	Not recorded.	Not recorded.	76·0	46·0	30·0	61·0	1·50	67	No observations.	No observations.	
February ...			79·0	46·0	33·0	62·5	1·10	63			
March ...			80·0	50·0	30·0	65·0	2·11	81			
April ...			75·0	53·0	22·0	64·0	8·33	94			
May			73·0	50·0	23·0	61·5	1·80	87			
June			71·0	45·0	26·0	58·0	0·49	86			
July			71·0	45·0	26·0	58·0	0·28	87			
August ...			70·0	46·0	24·0	58·0	0·33	83			
September ...			76·0	46·0	30·0	61·0	0·18	74			
October ...			76·0	50·0	26·0	63·0	0·92	77			
November ...			74·0	50·0	24·0	62·5	3·25	80			
December ...			76·0	46·0	30·0	61·0	1·54	67			
Year Average...	—	—	75·0	48·0	27·0	61·5	Total 21·83	79	—	—	

TABLE V—*continued.*

METEOROLOGICAL RETURN FOR THE YEAR 1921—*continued.*

MOMBASA.

MONTH.	TEMPERATURE.						RAINFALL.		WINDS.		Remarks.
	Solar Maximum.	Maximum on grass.	Shade Maximum.	Shade Minimum.	Range.	Max. and Min. Mean combined.	Amount in inches.	Degree of Humidity.	General Direction.	Average Force.	
								%			
January ...	Not recorded.	Not recorded.	87·0	71·0	16·0	79·0	1·14	78	Not recorded.	Not recorded.	
February ...			86·0	72·0	14·0	79·0	0·00	70			
March ...			87·0	74·0	13·0	80·5	2·43	72			
April... ...			86·0	72·0	14·0	79·0	15·84	79			
May			87·0	72·0	15·0	79·5	7·85	81			
June			87·0	72·0	15·0	79·5	3·29	78			
July			82·0	70·0	12·0	76·0	3·16	78			
August ...			81·0	70·0	11·0	75·5	1·85	78			
September ...			82·0	70·0	12·0	76·0	1·95	91			
October ...			84·0	71·0	13·0	77·5	0·42	71			
November ...			86·0	73·0	13·0	79·5	1·03	72			
December ...			86·0	74·0	12·0	80·0	0·19	69			
Year Average	—	—	85·0	72·0	13·0	78·5	Total 39·15	76	—	—	

KISUMU.

MONTH.	TEMPERATURE.						RAINFALL.		WINDS.		Remarks.
	Solar Maximum.	Maximum on grass.	Shade Maximum.	Shade Minimum.	Range.	Max. and Min. Mean combined.	Amount in inches.	Degree of Humidity.	General Direction.	Average Force.	
								%			
January ...	Not recorded.	Not recorded.	85·0	64·0	21·0	74·5	1·19	69	Not recorded.	Not recorded.	
February ...			85·0	63·0	22·0	74·0	4·18	58			
March ...			83·0	64·0	19·0	73·5	1·60	60			
April... ...			85·0	65·0	20·0	75·0	3·01	59			
May			81·0	65·0	16·0	73·0	6·97	70			
June			81·0	65·0	16·0	73·0	3·73	74			
July			79·0	62·0	17·0	70·5	7·66	72			
August ...			80·0	62·0	18·0	71·0	2·61	58			
September ...			83·0	63·0	20·0	73·0	1·47	51			
October ...			84·0	63·0	21·0	73·5	2·77	50			
November ...			85·0	65·0	20·0	75·0	2·39	70			
December ...			87·0	65·0	22·0	76·0	3·48	42			
Year Average	—	—	83·0	64·0	19·0	73·5	Total 41·06	61	—	—	

TABLE V—*continued.*

METEOROLOGICAL RETURN FOR THE YEAR 1921—*continued.*

FORT-HALL.

MONTH.	TEMPERATURE.						RAINFALL.		WINDS.		Remarks.
	Solar Maximum.	Maximum on grass.	Shade Maximum.	Shade Minimum.	Range.	Max. and Min. Mean combined.	Amount in inches.	Degree of Humidity.	General Direction.	Average Force.	
January ...	Not recorded.	Not recorded.	85	48	37	66·5	0·50	No instruments.	Not recorded.	Not recorded.	
February ...			88	47	41	67·5	0·00				
March ...			89	47	42	68·0	3·18				
April... ...			80	59	21	69·5	8·85				
May			78	60	18	69·0	6·66				
June			74	56	18	65·0	1·58				
July			75	55	20	65·0	0·53				
August ...			74	56	18	65·0	0·31				
September ...			77	58	19	67·5	0·07				
October ...			85	57	28	70·0	1·81				
November ...			80	58	22	69·0	3·16				
December ...			80	54	26	67·0	1·18				
Year Average	—	—	80	55	26	67·5	Total. 27·83	—	—	—	

TABLE VI.

RETURN OF DISEASES AND DEATHS (IN-PATIENTS) FOR THE YEAR 1921.

DISEASES.	EUROPEAN OFFICIALS.					NON-EUROPEAN OFFICIALS.					GENERAL EUROPEAN POPULATION.					GENERAL NATIVE POPULATION.				
	Remaining in Hospital at end of 1920.	Yearly Total.		Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Yearly Total.		Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Yearly Total.		Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Yearly Total.		Total cases treated.	Remaining in Hospital at end of 1921.
		Admissions.	Deaths.				Admissions.	Deaths.				Admissions.	Deaths.				Admissions.	Deaths.		
INFECTIVE DISEASES :—																				
Beri-beri	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	37	5	43	3
Cerebro-spinal fever	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	61	41	62	...
Chicken-pox	...	..	...	...	...	...	3	...	3	...	...	7	...	7	...	22	723	...	745	60
Cholera	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dengue	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	...	...	...	...
Diphtheria	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dysentery	...	16	...	16	...	...	94	...	94	...	1	17	1	18	1	9	415	45	424	9
Endocarditis—Infective...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Enteric	1	6	...	7	1	...	...	...	...	...	2	25	5	27	...	2	11	1	13	2
Erysipelas	...	1	...	1	...	...	...	...	...	...	...	1	...	1	...	...	1	...	1	...
Gonorrhœa...	...	1	...	1	...	3	6	...	9	1	...	2	...	2	...	18	241	1	259	13
Influenza	...	73	...	73	...	13	519	...	532	6	...	11	...	11	...	39	590	12	629	15
Kala Azar	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...
Leprosy (*a*) Nodular	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	10	2	15	5
(*b*) Anæsthetic	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	19	3	21	8
Malaria (*a*) Tertian	1	108	...	109	1	10	1057	...	1067	8	5	126	...	131	1	17	1360	17	1377	19
(*b*) Quartan	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	2	1
(*c*) Æstivo-autumnal ...	1	43	...	44	2	6	337	...	343	2	...	42	...	42	2	22	1370	10	1392	10
(*d*) Chronic malaria ...	...	1	...	1	...	...	25	...	25	...	...	1	...	1	...	...	280	...	280	14
(*e*) Blackwater	...	5	1	5	1	...	11	3	11	...	...	5	...	5	...	...	4	1	4	...
Measles	...	2	...	2	...	...	9	...	9	...	...	4	...	4	...	...	252	1	252	7
Malta fever	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plague	...	...	...	...	...	...	1	...	1	...	...	2	2	2	...	5	109	53	114	...
Pneumonia	...	3	...	3	...	1	10	3	11	...	...	6	2	6	...	38	971	249	1009	26
Rabies	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Relapsing fever	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	25	4	27	...
Rheumatic fever	...	...	...	...	...	2	...	...	2	...	1	...	...	1	...	5	...	...	5	...
Septicæmia	...	...	...	...	...	...	...	...	...	...	...	3	1	3	1	...	5	4	5	...
Trypanosomiasis (Sleeping sickness) ...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	4	...	1	4	...
Small-pox	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	1	6	1	7	...
Syphilis (*a*) Primary	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	...	...	16	...
(*b*) Secondary	...	...	...	...	...	...	2	...	2	...	...	2	...	2	...	15	798	4	813	51
(*c*) Inherited	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	38	2	39	1
Tetanus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	4	9	1
Tuberculosis	1	1	...	2	...	...	4	1	4	..	...	7	1	7	1	5	137	67	142	9
Whooping cough	...	...	...	...	...	...	...	...	...	...	1	1	...	2	...	...	1	...	1	...
Yaws	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	26	6660	2	6686	311
Yellow fever	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Mumps	...	1	...	1	...	...	5	...	5	...	...	1	...	1	...	4	55	1	59	...
Anthrax	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	17	2	21	1
Typhus	...	3	...	3	...	...	...	...	...	...	...	4	...	4	...	...	...	...	...	...
Other Infective Diseases	1	...	...	1	...	...	...	...	...	...	...	3	...	3	...	...	7	1	7	1
INTOXICATIONS :—																				
Alcoholism	...	...	...	...	...	...	...	...	...	...	1	2	...	3	...	...	1	...	1	...
Morphinism	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Others	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...
GENERAL DISEASES :—																				
Anæmia	...	2	...	2	...	...	4	...	4	...	...	4	...	4	...	2	71	8	73	3
Anæmia—Pernicious	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	2	...
Diabetes	...	1	1	1	...	...	2	...	2	...	...	...	...	...	...	...	...	...	...	...
Exophthalmic goitre	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...
Gout	...	1	...	1	...	...	1	...	1	...	...	...	...	...	...	...	2	...	2	...
Leucocythæmia	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hodgkin's disease	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Myxœdema	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Purpura	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Rickets	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...
Scurvy	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	1	29	1	30	...
Other General Diseases	1	20	...	21	...	1	119	...	120	3	...	23	...	23	2	6	320	12	326	6
LOCAL DISEASES: —																				
Diseases of the Nervous System :—																				
Sub-section 1.																				
Neuritis	...	4	...	4	...	...	2	...	2	...	...	2	...	2	...	...	8	...	8	...
Meningitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	10	7	10	1
Myelitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	1	3	...
Hydrocephalus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Encephalitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	1	...	1	...
Abscess of brain	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Congestion of brain	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other Diseases	2	...	...	2	...	...	...	...	...	...	1	3	2	4	...	...	5	1	5	...
Sub-section 2.																				
Apoplexy	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	3	3	3	...
Paralysis	...	...	...	...	...	...	2	...	2	...	...	...	...	...	...	6	17	5	23	5
Chorea	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Epilepsy	...	1	...	1	...	...	2	...	2	...	...	...	...	...	...	1	15	5	16	1
Neuralgia	...	5	...	5	...	...	42	...	42	...	...	1	...	1	...	1	51	...	52	...
Hysteria	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	2	...	2	...
Other Nervous Diseases	...	5	...	5	...	3	26	...	29	2	1	5	...	6	...	4	102	2	106	3
Mental Diseases—																				
Sub-section 3.																				
Idiocy	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	2	...	4	2
Mania	...	...	...	...	...	1	...	...	1	...	4	1	...	5	4	33	39	16	72	35
Melancholia	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	2	...	3	1
Dementia	...	...	...	...	...	...	...	...	...	...	...	2	...	2	2	15	15	5	30	17
Delusional insanity	...	1	...	1	...	...	1	...	1	...	...	4	...	4	1	9	13	4	22	8
Other Mental Diseases	...	...	...	...	...	...	4	...	4	...	2	9	1	11	1	7	22	...	29	12

TABLE VI.—RETURN OF DISEASES AND DEATHS (IN-PATIENTS) FOR THE YEAR 1921—(*contd.*).

DISEASES.	EUROPEAN OFFICIALS.					NON-EUROPEAN OFFICIALS.					GENERAL EUROPEAN POPULATION.					GENERAL NATIVE POPULATION.				
	Remaining in Hospital at end of 1920.	Yearly Total. Admissions.	Yearly Total. Deaths.	Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Yearly Total. Admissions.	Yearly Total. Deaths.	Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Yearly Total. Admissions.	Yearly Total. Deaths.	Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Yearly Total. Admissions.	Yearly Total. Deaths.	Total cases treated.	Remaining in Hospital at end of 1921.
LOCAL DISEASES—*continued* :—																				
Diseases of the Eye—																				
Conjunctivitis ...	...	2	...	2	...	...	59	...	59	...	...	...	...	...	...	6	230	...	236	4
Keratitis	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	15	...	15	...
Ulceration of cornea ...	...	...	...	...	...	...	13	...	13	1	...	...	...	...	...	1	18	...	19	1
Iritis	...	1	...	1	...	1	2	...	3	...	...	...	...	...	...	...	16	...	16	...
Optic neuritis ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cataract...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	1	3	...	4	2
Other Eye Diseases	...	2	...	2	...	1	28	...	29	...	...	2	...	2	...	2	35	...	37	1
Diseases of the Ear :—																				
Inflammation ...	...	1	...	1	...	...	3	...	3	...	...	1	...	1	..	...	34	...	34	...
Other Diseases ...	...	1	...	1	...	...	6	...	6	...	...	5	1	5	...	...	14	...	14	...
Diseases of the Nose	...	8	...	8	...	...	85	...	85	...	...	4	...	4	...	...	30	...	30	1
Diseases of the Circulatory System :—																				
Pericarditis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	4	5	...
Endocarditis ...	...	...	...	...	...	...	...	...	...	...	...	3	2	3	...	...	1	...	1	...
Valvular, Mitral	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	1	15	7	16	1
,, Aortic	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	4	...
,, Tricuspid ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...
,, Pulmonary ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Arterial sclerosis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Aneurism	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other Diseases ...	...	6	1	6	...	...	...	...	...	...	...	4	...	4	...	1	17	4	18	...
Diseases of the Respiratory System :—																				
Laryngitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	...	14	...
Bronchitis	...	23	...	23	...	3	199	2	202	2	...	6	...	6	...	21	972	6	993	16
Broncho-pneumonia ...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	1	71	21	72	1
Abscess of lung	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gangrene of lung	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Emphysema	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...
Pleurisy	1	2	...	3	...	...	5	...	5	...	...	3	...	3	...	3	33	3	36	1
Empyema	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	6	...	7	...
Other Diseases ...	...	5	...	5	...	2	67	...	69	1	1	10	...	11	1	1	55	4	56	2
Diseases of the Digestive System :—																				
Stomatitis	...	...	...	...	...	...	4	...	4	...	...	...	...	...	...	...	17	...	17	...
Caries of teeth...	...	7	..	7	...	1	22	...	23	...	...	4	...	4	...	...	7	...	7	...
Glossitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sore throat	...	4	...	4	...	...	5	...	5	...	...	5	...	5	...	...	30	...	30	1
Inflammation of tonsils	...	32	...	32	1	...	38	...	38	...	1	24	1	25	3	...	41	1	41	1
Gastritis	1	9	...	10	...	...	20	...	20	...	...	11	...	11	...	...	19	1	19	...
Ulceration of stomach	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	2	1	2	...
Hæmatemesis ...	...	1	...	1	1	...	...	...	...	...	1	1	...	2	...	...	...	...	...	...
Dilatation of stomach	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Stricture of stomach ...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dyspepsia	...	2	...	2	...	2	30	...	32	1	1	6	...	7	...	...	41	...	41	...
Enteritis	1	3	...	4	...	...	...	...	...	...	...	7	1	7	...	...	25	5	25	...
Appendicitis ...	...	8	1	8	...	...	...	...	...	...	...	27	3	27	2	...	4	1	4	...
Colitis ...	...	2	...	2	...	...	1	...	1	...	...	...	...	...	...	...	18	...	18	1
Ulceration of intestines	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...
Sprue ..	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hernia ...	...	3	...	3	...	1	...	...	1	...	...	4	...	4	...	2	60	6	62	2
Diarrhœa	...	17	...	17	...	...	130	...	130	1	...	18	1	18	1	9	392	15	401	11
Constipation ...	...	2	...	2	...	1	26	...	27	...	...	3	...	3	...	...	78	...	78	...
Colic ...	...	14	...	14	...	1	73	...	74	...	...	9	...	9	1	1	79	...	80	...
Hæmorrhoids ...	...	4	...	4	1	1	23	...	24	...	...	3	...	3	...	...	8	...	8	...
Pancreatitis ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...
Hepatitis (Acute)	...	5	...	5	...	...	2	...	2	..	...	9	...	9	...	1	12	1	13	...
Abscess ...	...	1	...	1	...	...	...	...	...	..	...	2	...	2	...	1	5	1	6	...
Cirrhosis	...	...	...	...	...	...	2	1	2	...	...	...	...	...	...	1	12	7	13	1
Jaundice	...	2	...	2	...	...	...	...	...	...	...	1	...	1	...	...	9	...	9	...
Peritonitis	...	...	...	...	...	...	...	...	...	..	...	1	1	1	...	...	7	7	7	...
Ascites ...	...	...	...	...	...	...	1	...	1	..	...	...	...	...	...	...	9	2	9	1
Other Diseases	...	2	...	2	...	...	33	...	33	1	...	9	...	9	1	...	37	5	37	3
Diseases of the Lymphatic System :—																				
Splenitis	...	...	...	...	...	...	11	...	11	...	...	...	...	...	...	1	18	...	19	...
Inflammation of lymphatic gland ...	...	2	...	2	...	...	13	...	13	...	...	2	...	2	...	16	135	1	151	6
Suppuration of lymphatic gland ...	...	1	...	1	...	1	1	...	2	...	...	...	...	...	...	...	15	...	15	...
Lymphangitis ...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	2	...	2	..
Elephantiasis ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	4	2
Other Diseases	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	3	...
Diseases of the Urinary System:—																				
Acute nephritis	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	4	...	4	1
Bright's disease	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	7	5	8	...
Pyelitis ...	...	...	...	...	...	...	1	...	1	...	...	1	...	1	...	...	1	...	1	...
Calculus	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...
Renal colic	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	4	...	4	...
Cystitis ...	...	2	...	2	...	...	3	...	3	...	...	3	...	3	...	...	9	1	9	...
Vesical calculus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Suppression ...	..	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	...	...	...	...
Hæmaturia	...	1	...	1	...	...	...	...	...	...	...	1	...	1	...	...	2	...	2	...
Chyluria	...	..	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other Diseases...	...	5	...	5	...	...	3	..	3	...	...	2	...	2	...	3	12	2	15	...

TABLE VI.—RETURN OF DISEASES AND DEATHS (IN-PATIENTS) FOR THE YEAR 1921—(*contd.*).

DISEASES.	EUROPEAN OFFICIALS.					NON-EUROPEAN OFFICIALS.					GENERAL EUROPEAN POPULATION.					GENERAL NATIVE POPULATION.				
		YEARLY TOTAL.					YEARLY TOTAL.					YEARLY TOTAL.					YEARLY TOTAL.			
	Remaining in Hospital at end of 1920.	Admissions.	Deaths.	Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Admissions.	Deaths.	Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Admissions.	Deaths.	Total cases treated.	Remaining in Hospital at end of 1921.	Remaining in Hospital at end of 1920.	Admissions.	Deaths.	Total cases treated.	Remaining in Hospital at end of 1921.
LOCAL DISEASES—*continued*—																				
Diseases of the Generative System :—																				
Male Organs :—																				
Urethritis	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	2	...	2	...
Gleet	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Stricture	...	...	...	...	...	...	...	...	...	...	...	6	...	6	...	1	9	...	10	...
Prostatitis	...	...	...	...	...	...	...	...	...	...	...	3	...	3	...	...	1	...	1	...
Soft chancre	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	3	38	...	41	...
Condyloma	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	6	...	7	...
Inflammation of scrotum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Hydrocele	..	1	...	1	...	...	2	...	2	...	...	...	...	...	...	...	22	...	22	1
Orchitis	...	1	...	1	...	...	2	...	2	1	1	3	...	4	...	3	58	...	61	2
Epididymitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	3	...
Abscess of testicle	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Other Diseases	...	1	...	1	...	...	...	...	...	...	...	2	...	2	...	1	43	...	44	3
Female Organs :—																				
Ovaritis	...	...	...	...	...	...	...	...	...	...	...	2	...	2	...	...	1	...	1	...
Ovarian cyst	...	...	...	...	...	...	...	...	...	...	...	1	1	1	...	...	4	1	4	...
Endometritis	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Displacement of uterus	...	...	...	...	...	...	...	...	...	...	...	5	1	5	...	...	...	...	...	...
Vaginitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...
Amenorrhœa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dysmenorrhœa	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	4	...	4	...
Menorrhagia	...	1	...	1	...	...	...	...	...	...	...	5	...	5	...	...	...	...	...	...
Leucorrhœa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Abortion	...	...	...	...	...	...	...	...	...	...	1	12	...	13	1	1	8	...	9	...
Delayed labour	...	...	...	...	...	...	..	...	...	...	...	4	...	4	...	1	14	6	15	...
Post-partem hæmorrhage	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Retained placenta	...	...	...	...	...	...	...	...	...	...	...	2	...	2	1	...	4	...	4	...
Premature birth	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	3	...
Puerperal septicæmia	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	1	1	1	...
Mastitis	...	...	...	...	...	...	...	...	...	...	...	3	...	3	...	...	2	...	2	...
Abscess of breast	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1	...	4	...	4	...
Other Diseases	...	...	...	...	...	...	...	...	...	...	...	12	...	12	...	...	11	1	11	...
Diseases of the Organs of Locomotion :—																				
Osteitis	...	...	...	...	...	...	...	...	...	...	...	2	...	2	...	1	10	...	11	2
Arthritis	...	1	...	1	...	...	78	...	78	1	...	...	...	...	...	...	176	...	176	6
Spondylitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	1	...	2	1
Bursitis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	4	...
Other Diseases	...	15	...	15	...	2	139	...	141	2	...	10	...	10	...	10	477	3	487	33
Diseases of the Connective Tissue :—																				
Cellulitis	...	10	...	10	...	1	14	...	15	...	1	25	...	26	...	7	326	4	333	13
Abscess	...	7	...	7	...	...	44	...	44	1	...	11	...	11	...	12	324	4	336	20
Elephantiasis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	14	...	14	...
Other Diseases	...	2	...	2	...	1	10	...	11	...	...	4	...	4	...	25	250	6	275	26
Diseases of the Skin :—																				
Urticaria	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	4	...
Eczema	..	3	...	3	...	...	9	...	9	...	...	1	...	1	...	...	27	...	27	...
Boil	...	...	...	...	...	...	23	...	23	...	...	5	...	5	...	...	64	...	64	1
Carbuncle	...	4	...	4	...	...	21	...	21	...	...	...	...	...	...	...	12	...	12	...
Herpes	...	2	...	2	...	1	1	...	2	...	...	1	...	1	...	...	3	...	3	...
Psoriasis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	3	1
Oriental sore	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Tinea	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	4	...
Scabies	...	...	...	...	...	...	20	...	20	...	...	...	...	...	...	8	146	...	154	8
Acne	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...
Prickly heat	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...
Other Diseases	...	3	...	3	...	...	7	...	7	...	1	7	...	8	1	24	555	1	579	48
Injuries—General	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	34	11	34	13
Local	...	46	...	46	2	9	365	...	374	8	1	74	2	75	1	113	2906	36	3019	173
Gun-shot Wounds	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Surgical Operations *	2	9	...	11	...	...	...	...	...	...	1	12	...	13	...	...	(72)	...	(72)	(3)
Tumours	...	2	...	2	...	...	1	...	1	...	1	2	...	3	...	1	44	6	45	3
Malformations	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Poisons	...	2	...	2	...	...	1	...	1	...	...	...	...	...	...	...	22	1	22	...
Parasites—Animal	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	1	...
Protozoa	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	2	...
Trematoda (Flukes)	...	...	...	...	...	...	...	...	...	...	...	1	...	1	1	...	11	...	11	1
Cestoda—																				
Tænia solium	...	1	...	1	...	...	...	...	...	...	...	2	...	2	...	...	23	...	23	1
Tænia saginata	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	80	1	80	5
Nematoda—																				
Ascaris	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	64	...	64	9
Tricocephalus dispar	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	15	...	15	3
Trichina	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Dracunculus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Filariasis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	3	...
Strongylus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	6	...	7	2
Ankylostomiasis	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	4	82	10	86	7
Oxyuris	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	2	...
Insecta—																				
Myiasis	...	1	...	1	...	...	9	...	9	1	...	1	...	1	...	...	30	...	30	1
Other Diseases	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	1	. .	...	1	...
TOTAL	11	592	4	603	10	69	3951	10	4020	43	29	738	31	767	31	653	23634	809	24287	1104

* Recorded under respective diseases.

TABLE VII.

RETURN OF DISEASES (OUT-PATIENTS) FOR THE YEAR 1921.

DISEASES.	EUROPEAN OFFICIALS.		NON-EUROPEAN OFFICIALS.		GENERAL EUROPEAN POPULATION.		GENERAL NATIV POPULATION.	
	Male.	Female.	Male.	Female.	Male.	Female.	Male.	Female.
Infective Diseases :—								
Beri-beri	...	...	...	...	...	...	1	...
Cerebro-spinal fever	...	...	...	...	...	...	10	...
Chicken-pox	...	...	...	...	...	1	247	3
Cholera	...	...	...	...	...	...	...	...
Dengue	...	...	...	...	...	...	...	...
Diphtheria	...	...	...	...	...	...	...	...
Dysentery	1	...	3	...	4	1	539	84
Endocarditis—Infective	...	...	...	...	...	...	...	...
Enteric fever	...	...	...	...	1	...	...	...
Erysipelas	...	...	...	...	...	...	4	...
Gonorrhœa	8	...	1	...	9	...	905	15
Influenza	4	...	42	...	6	4	1,417	93
Kala Azar	...	...	...	...	...	...	...	...
Leprosy (*a*) Nodular	...	...	...	...	...	...	9	3
(*b*) Anæsthetic	...	...	...	...	...	...	1	...
Malaria (*a*) Tertian	69	1	180	...	34	15	5,215	505
(*b*) Quartan	...	...	5	...	...	1	93	16
(*c*) Æstivo-autumnal	17	...	133	...	5	10	4,321	881
(*d*) Chronic malaria	1	...	4	...	...	2	859	135
(*e*) Blackwater	...	...	...	...	2	...	...	1
Measles	1	...	...	...	1	...	196	2
Malta fever	...	...	...	...	...	...	...	...
Plague	...	...	...	...	...	...	33	...
Pneumonia	...	...	...	...	3	2	200	38
Rabies	...	...	...	...	...	...	...	...
Relapsing fever	...	...	...	...	...	...	36	1
Rheumatic fever	...	...	...	...	...	...	...	...
Septicæmia	...	...	...	...	...	...	...	...
Trypanosomiasis (Sleeping Sickness)	...	...	...	...	...	...	...	...
Small-pox	...	...	...	...	...	...	2	...
Syphilis (*a*) Primary	...	...	...	...	...	...	...	...
(*b*) Secondary	...	...	1	...	3	...	972	171
(*c*) Inherited	...	...	...	...	...	...	56	41
Tetanus	...	...	...	...	...	...	3	1
Tuberculosis	...	...	2	...	...	...	104	33
Whooping cough	...	...	...	...	...	...	14	2
Yaws	...	...	...	...	...	...	416	325
Yellow fever	...	...	...	...	...	...	...	...
Mumps	...	...	...	...	...	...	64	7
Anthrax	...	...	...	...	...	...	17	...
Other Infective Diseases	...	...	...	...	...	...	2	...
Intoxications :—								
Alcoholism	...	...	...	...	1	...	1	...
Morphinism	...	...	...	...	...	...	...	...
Others	...	...	...	...	...	...	...	...
General Diseases :—								
Anæmia	9	...	26	...	6	7	309	77
Anæmia—Pernicious	4	...	...	...	...	...	2	...
Diabetes	...	...	1	...	...	...	2	...
Exophthalmic Goitre	...	...	...	...	...	...	...	...
Gout	...	...	...	...	...	...	15	...
Leucocythæmia	...	...	...	...	...	...	...	...
Hodgkin's Disease	...	...	...	...	...	...	...	...
Myxœdema	...	...	...	...	...	...	...	...
Purpura	...	...	...	...	...	...	...	...
Rickets	...	...	...	...	...	...	4	1
Scurvy	...	...	...	...	...	...	7	...
Other General Diseases	23	2	17	...	12	19	474	33
Local Diseases :—								
Diseases of the Nervous System	26	...	138	...	20	18	3,836	308
Mental Diseases	...	...	...	...	4	...	13	2
Diseases of the Eye	8	...	45	...	6	2	3,877	1,019
,, ,, Ear	14	2	37	...	17	14	1,635	337
,, ,, Nose	17	1	97	...	8	7	807	73
,, ,, Circulatory System	5	...	...	...	4	2	60	3
,, ,, Respiratory System	47	2	217	...	26	13	17,059	1,855
,, ,, Digestive System	176	4	480	...	103	85	16,990	2,765
,, ,, Lymphatic System	1	...	9	...	1	1	884	87
,, ,, Urinary System	1	1	3	...	...	3	65	7
,, ,, Generative System	9	1	3	...	17	19	432	182
,, ,, Organs of Locomotion	16	...	99	...	9	8	5,723	563
,, ,, Connective Tissue	25	3	16	...	27	4	2,841	337
,, ,, Skin	45	3	158	...	40	23	11,322	2,011
Injuries :—								
General	4	...	3	...	...	...	8	21
Local	106	7	163	...	101	25	45,243	11,602
Gun-shot wounds	...	...	...	...	...	...	...	...
Surgical Operations*	(3)	...	...	...	(22)	...	(548)	(67)
Tumours	2	...	...	...	1	2	36	7
Malformations	...	...	...	...	...	...	...	1
Poisons	1	...	...	...	...	1	56	5
Parasites—Animal	8	1	13	...	12	4	2,209	899
TOTAL	648	28	1,896	...	483	293	129,646	24,552

* Recorded under respective Diseases.

TABLE VIII.

EUROPEANS.

RETURN OF INFECTIVE DISEASES TREATED AT THE VARIOUS HOSPITALS AND DISPENSARIES IN THE COLONY & PROTECTORATE OF KENYA DURING 1921.

DISEASES.		Mombasa.	Malindi.	Voi.	Lamu.	Kilindini.	Kismayu.	Gobwen.	Moyale.	Serenli.	Kisumu.	Kericho.	Kakamega.	Nandi.	Kisii.	Fort-Hall.	Meru.	Nyeri.	Embu.	Kitui.	Nairobi.	Makindu.	Machakos.	Kyambu.	Mueressi.	Nakuru.	Naivasha.	Eldama Ravine.	Londiani.	Narok.	Rumuruti.	Kabarnet.	Eldoret.	Kacheliba	Total.
Chicken-pox	Admissions	1	...	...	...	...	..	...	...	...	...	...	...	3	...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	1	...	8
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
Dysentery ...	Admissions	8	...	...	...	...	...	...	...	...	...	4	1	...	...	...	...	...	2	...	16	...	...	...	...	3	2	...	...	...	...	...	3	...	39
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Enteric Fever	Admissions	5	...	...	...	4	...	...	...	...	1	...	...	...	...	...	...	...	...	...	19	...	1	...	...	...	...	...	...	...	...	...	1	...	31
	Deaths ...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	1	...	...	...	...	...	..	...	...	...	...	...	5
Influenza ...	Admissions	7	...	...	...	4	...	...	...	...	2	1	...	...	2	...	...	5	...	...	62	...	3	1	...	4	4	...	...	3	...	...	...	...	98
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
Malaria ...	Admissions	155	6	12	2	40	9	3	...	24	58	9	9	2	...	5	1	11	...	1	58	7	4	2	3	1	6	4	6	...	1	7	29	1	476
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
Blackwater Fever	Admissions	2	...	1	...	...	...	...	...	...	3	...	...	...	...	1	...	...	...	...	4	...	...	...	1	...	...	...	...	...	...	...	...	...	12
	Deaths ...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Measles ...	Admissions	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	1	...	8
	Deaths ...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
Plague ...	Admissions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2
	Deaths ..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Pneumonia ...	Admissions	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	...	...	...	...	...	...	1	3	1	...	...	...	...	14
	Deaths ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Tuberculosis	Admissions	...	...	...	...	...	...	...	...	...	...	.	...	...	...	...	...	...	...	...	7	...	...	...	...	...	...	...	...	...	...	...	1	...	8
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	1
Mumps ...	Admissions	...	...	...	...	...	...	...	...	..	1	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
Typhus ...	Admissions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	...	...	...	...	...	...	...	...	...	...	...	...	...	7
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	—

N.B.—This Table only gives the numbers *actually* treated at Government Institutions.

TABLE VIII.

NATIVES (INCLUDING ASIATICS).

RETURN OF INFECTIVE DISEASES TREATED AT THE VARIOUS HOSPITALS AND DISPENSARIES IN KENYA COLONY & PROTECTORATE DURING 1921.

DISEASES.		Mombasa.	Malindi.	Voi.	Lamu.	Kilindini.	Kismayu.	Gobwen.	Moyale.	Serenli.	Kisumu.	Kericho.	Kakamega.	Nandi.	Kisii.	Fort-Hall.	Meru.	Nyeri.	Embu.	Kitui.	Chuka.	Nairobi.	Makindu.	Machakos.	Kyambu.	Mueressi.	Nakuru.	Naivasha.	Eldama Ravine.	Londiani.	Kabarnet.	Eldoret.	Kacheliba.	Narok.	Rumuruti.	Total.
Beri-beri	Admissions	...	...	...	...	...	...	...	...	9	3	2	...	...	...	...	...	...	...	...	...	4	11	2	...	...	...	...	...	6	...	1	...	...	...	38
	Deaths ...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	5
Cerebro-spinal fever ...	Admissions	7	1	...	...	...	...	...	...	...	10	...	...	...	1	7	...	...	1	1	...	34	...	...	...	...	4	1	4	...	...	...	...	...	...	71
	Deaths ...	6	1	...	...	...	...	...	...	...	6	...	...	...	...	4	...	...	1	1	...	15	...	...	...	...	2	1	4	...	...	...	...	...	...	41
Chicken-pox	Admissions	13	...	3	1	1	...	...	...	...	16	33	...	4	29	25	1	9	1	...	...	476	1	10	8	...	138	77	33	27	...	31	1	6	32	976
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
Dysentery	Admissions	73	9	23	19	27	20	1	30	24	114	24	...	22	...	13	18	16	9	15	...	356	26	8	20	12	115	29	11	16	1	30	19	12	23	1,135
	Deaths ...	6	...	...	...	...	...	...	...	...	8	...	...	...	...	...	4	3	...	1	...	10	4	1	...	...	6	...	1	1	...	...	...	...	...	45
Enteric fever	Admissions	2	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	6	...	...	...	...	...	...	...	...	...	...	...	1	...	11
	Deaths ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Influenza	Admissions	197	21	4	...	92	17	...	7	...	1	213	9	2	2	161	163	89	1	...	...	775	4	32	53	...	567	55	107	...	1	15	14	63	5	2,661
	Deaths ...	...	...	1	...	...	...	...	...	...	...	1	...	...	...	1	...	2	...	...	...	...	...	...	...	...	...	4	...	...	...	3	...	...	...	12
Leprosy	Admissions	3	1	...	...	...	4	...	...	...	6	...	9	...	5	4	...	1	1	1	...	3	...	...	...	...	2	...	...	...	...	1	...	1	...	42
	Deaths ...	2	...	...	...	...	1	...	...	...	...	...	...	...	...	1	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	5
Malaria	Admissions	1,468	766	317	1,732	815	486	705	178	582	2,171	186	140	99	197	1,097	290	718	223	308	2	1,540	437	101	339	222	189	105	321	358	10	297	125	2	158	16,777
	Deaths ...	1	1	3	...	1	...	...	...	...	4	1	...	...	...	...	...	2	...	...	...	5	2	...	3	...	...	2	...	...	...	2	...	...	...	27
Blackwater fever ...	Admissions	3	...	...	...	3	...	...	...	...	8	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	16
	Deaths ...	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	4
Measles	Admissions	21	5	...	...	25	...	...	...	...	2	...	1	2	2	4	...	1	...	...	...	292	...	4	10	2	14	1	2	...	11	13	...	47	...	459
	Deaths ...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Plague	Admissions	1	...	...	...	...	...	...	...	...	9	...	7	...	...	...	...	...	...	...	...	123	...	...	...	...	2	...	...	...	...	1	...	...	...	143
	Deaths ..	1	...	...	...	...	...	...	...	...	6	...	4	...	...	...	...	...	...	...	...	41	...	...	...	...	1	...	...	...	...	...	...	...	...	53
Pneumonia	Admissions	66	2	18	1	13	7	1	5	5	60	23	7	...	22	23	2	7	6	10	1	529	18	2	23	1	219	15	36	49	2	34	...	12	...	1,219
	Deaths ..	21	...	2	...	...	...	1	...	...	11	2	1	...	3	4	...	2	1	3	...	117	5	...	4	...	39	6	11	6	...	12	...	1	...	252
Small-pox	Admissions	5	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	8
	Deaths ...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Tuberculosis	Admissions	55	4	1	9	1	21	4	1	11	11	3	3	2	62	1	1	4	...	...	1	49	2	...	7	1	10	...	...	...	1	8	...	7	...	280
	Deaths ...	27	...	...	...	...	2	2	...	3	4	1	...	...	1	...	1	2	...	...	1	17	1	...	1	1	1	...	...	...	1	2	...	...	...	68
Yaws	Admissions	89	60	2	4	7	1	...	5	...	171	2	20	...	3,421	3,099	34	143	111	10	118	34	...	...	11	...	17	...	1	...	...	...	2	44	...	7,401
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	2
Mumps	Admissions	14	8	...	...	1	..	...	...	2	2	15	...	...	...	...	...	1	...	...	...	76	1	...	8	...	2	...	1	...	...	...	...	2	...	131
	Deaths ...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1
Typhus	Admissions	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	—
Anthrax	Admissions	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	26	...	5	...	2	...	...	...	...	...	...	...	...	...	34
	Deaths ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2

N.B.—This Table only gives the numbers *actually* treated at Government Institutions.

TABLE IX.

STATISTICS REGARDING ENTERIC FEVER AMONG EUROPEAN RESIDENTS IN COLONY AND PROTECTORATE OF KENYA DURING 1921.

Total Number Admitted on Account of Enteric.				Number Admitted who had been Previously Inoculated Against Enteric.		Number of Those who Died.				Total Number Inoculated Against Enteric Fever During the Year.	
						Previously Inoculated.		Not Previously Inoculated.			
Officials.		Non-Officials.		Officials.	Non-Officials.	Officials.	Non-Officials.	Officials.	Non-Officials.	Officials.	Non-Officials.
Cases.	Deaths.	Cases.	Deaths.								
6	—	26	5	—	2	—	2	—	3	5	15

The occurrence of the 32 cases was as follows :—

Nairobi	...	19	...	2 deaths.
Mombasa	...	9	...	2 „
Kisumu	...	1	...	—
Machakos	...	1	...	1 death.
Eldoret	...	1	...	—
Londiani	...	1	...	—

TABLE IXa.

SUMMARY OF LABORATORY REPORTS ON ENTERIC FEVER FOR 1921.

Agglutination	Reactions	88
	Negative	72
	Typhoid Positive	1
	Paratyphoid A Positive	7
	Paratyphoid B Positive	4
	Paratyphoid C Positive	nil.
Typhoid and	Paratyphoid A & B Positive	3
	Paratyphoid A & B Positive	1
	Blood Cultures 20 negative	20
	Fæces 21 negative	21

COLONY AND PROTECTORATE OF KENYA.

Annual Report

OF THE

BACTERIOLOGICAL LABORATORY

FOR THE YEAR 1921.

VOL. XII.

W. H. KAUNTZE,

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Senior Bacteriologist.

Seamen's Hospital Society
TROPICAL DISEASES
12 APR. 1923
LIBRARY

Annual Report

GOVERNMENT BACTERIOLOGICAL LABORATORY
COLONY AND PROTECTORATE OF KENYA.

1921.

I.—ORGANIZATION.

Dr. Kauntze returned from leave on September 16th and resumed the duties of Senior Bacteriologist, which up to that time had been carried out by Dr. Clearkin. The post of second Assistant Bacteriologist was filled by the appointment of Dr. Allen, who commenced his duties on March 11th. In November Dr. Hunter, of the Sanitation Division of the Medical Department, was attached temporarily to the Laboratory for duty, and remained there to the close of the year. The senior non-European laboratory assistant went on leave on February 23rd and returned to duty on May 31st. The second non-European laboratory assistant returned from leave on May 31st.

As the provision of a new laboratory has become a matter of decreasing probability owing to the increasing financial stress in the Colony, it has been found necessary to make alterations in the existing buildings to provide adequate accommodation for the increased staff. The old general office has therefore been converted into a laboratory and office for the Senior Bacteriologist, and his former office used as a workroom for one of the assistant bacteriologists and any medical officer temporarily attached for duty. The clerical staff has consequently been housed in a small room previously used as a store. Various improvements have been carried out in the calf sheds, as will be noted on a later page. It is hoped to reorganise the office staff and methods during 1922 so as to allow of the engagement of a shorthand typist, which will reduce the work of the bacteriologists considerably and set them free for more important duties than writing correspondence out in longhand so that the Goan clerk can type it out correctly. The erection of the ice plant will probably be carried out during the course of the coming year and this will reduce the time spent on the production of calf lymph by the saving of lymph at present unavoidably wasted owing to defective methods of storage.

The remarks made in my report of 1919 with regard to the necessity of the provision of a well-equipped and well-staffed laboratory to deal with the medical problems of the country still hold good, and I see no prospect of any really effective advance in the treatment and prevention of disease till the Medical Department is linked to such a laboratory. Routine clinical work and the production of calf lymph occupy most of the time of the staff, while problems of great economic importance to the Colony and Africa as a whole remain unsolved. Research has not yet come to its own in this country, and obvious revenue-producing investigations are more welcome than those whose utility is only discerned by a few far-sighted individuals.

2.—REPORT ON THE YEAR'S WORK.

A summary of the work done in the Laboratory during the year will be found in Appendix I. It is unfortunate that in a report such as this, it is impossible to record much of the minor research accomplished by the Laboratory staff, and it thus becomes only a record of routine work done. For the first time since the close of the war, two bacteriologists have been on duty together for a considerable portion of the year, and although the figures of examinations done do not reflect this fact, it has enabled more time to be devoted to each investigation, and to the production of a calf lymph which is not only satisfactory in taking properties but also tested before issue as to activity and as to its bacterial content. Dr. Allen, who is responsible for the production of calf lymph, had the advantage of two visits to the Government Lymph Station at Hendon. On his arrival here he was able, from his personal observations and from the advice kindly given by Dr. Blaxall, the Director of the Hendon Station, to suggest improvements in the technique. These are described by him in the next section of the report. The remaining routine work has followed more or less the lines laid down in former years, but various side issues have been investigated, partly with a view to improving the methods in use and partly to satisfy ourselves that the statements made by other workers are correct for this part of the world, for example, the effect of the air temperature and of the sun on a guinea-pig's body temperature has been tested in connection with the response to inoculation of pathogenic bacilli or viruses.

A.—THE PREPARATION OF VACCINE LYMPH.

(I)—SEED LYMPH.

(*a*) Lister Institute Lanolinated Seed Lymph.

For the first six months Lanolinated Seed Lymph, from the Lister Institute, was used entirely, but the results were not satisfactory. The seed lymph took some time to get to Mombasa, there were difficulties in transit from Mombasa to Nairobi, and storage in the Laboratory was not satisfactory. Then the lanolinated lymph itself, when planted out on agar, always gave an innumerable number of colonies per loopful and its keeping qualities were not good.

(*b*) Bombay Glycerinated Lymph.

One of the Indian laboratory assistants, when returning from leave in India, brought back a tube of Bombay Glycerinated Lymph. This was used to vaccinate two calves which yielded 2·0 and 7·7 grammes of pulp respectively. The lymph from these was used to vaccinate eight more calves, of which one gave a yield of 17 grammes, one of 3·8 grammes, and one of 7·7 grammes, while the remainder failed completely. Lymph made from selected vesicles from the 17 grammes yield was used as seed lymph for six more calves and all failed except one, which gave 9 grammes of poor quality pulp. Two more calves were vaccinated with no result, and two rabbits also failed, so the strain has not been tried further.

(*c*) Zanzibar Strain.

An outbreak of small-pox occurred in Zanzibar in October, 1921, originating from Bombay. Through the courtesy of the Medical Officer of Health, Zanzibar lymph was obtained from the vesicles of a patient. The Medical

Officer of Health selected a case of moderate severity with a profuse rash, discrete in type, and terminating in recovery. The serum was taken from non-purulent vesicles on the seventh day, drawn up into twenty-four capillary tubes, packed in Thermos flasks with ice, and dispatched to Nairobi on 5th October, 1921. The flasks did not arrive in Nairobi until 14th October, and unfortunately were broken in transit. Calf Nos. 185 and 186 were vaccinated the same day, and five days later 1·4 grammes of pulp was taken from calf No. 185, calf No. 186 giving no yield. No vesicles formed on calf No. 185, the only result being some slight thickening and œdema of the incisions. Two days later rabbit No. 14 was vaccinated with lymph No. 185, and 16 poor vesicles developed, which were removed and emulsified, and the same day calf No. 195 was vaccinated from the resulting lymph. The yield was again poor, 5·9 grammes of pulp being obtained. From this two calves were vaccinated, one of which (192) gave a yield of 13·2 grammes of excellent quality pulp, the vesicles being firm and in almost unbroken lines. From the other (199), selected vesicles were taken. The strain has now been carried through 11 rabbits and 33 calves. A table showing the history of the strain to date is given overleaf.

The failures with the Zanzibar strain were due to the use of very poor calves, healthy calves not being available towards the end of the year owing to drought.

The first transfer from rabbit to calf generally gave a poor result, but the pulp from the transfer to the next calf as a rule was good.

Some of the calves gave very good vesiculation, No. 232 giving a yield of 27·8 grammes of pulp. The results were more uniform after the fourth transfer, the earlier transfers, with two exceptions, giving poor visculation.

(*d*) Belgaum Seed Lymph.

Seed lymph was obtained from the Vaccine Institute, Belgaum, India. The results were very uneven. Six calves and one rabbit were vaccinated. One calf, No. 197, gave a good yield, and all the others failed completely. From the calf No. 197 two calves were vaccinated, one giving a good yield, the other failing. Five transfers were then made with fair results, but after this the strain gave poor vesculation and two rabbits were used for rejuvenation, with marked success.

(II)—PREPARATION OF CALF LYMPH.

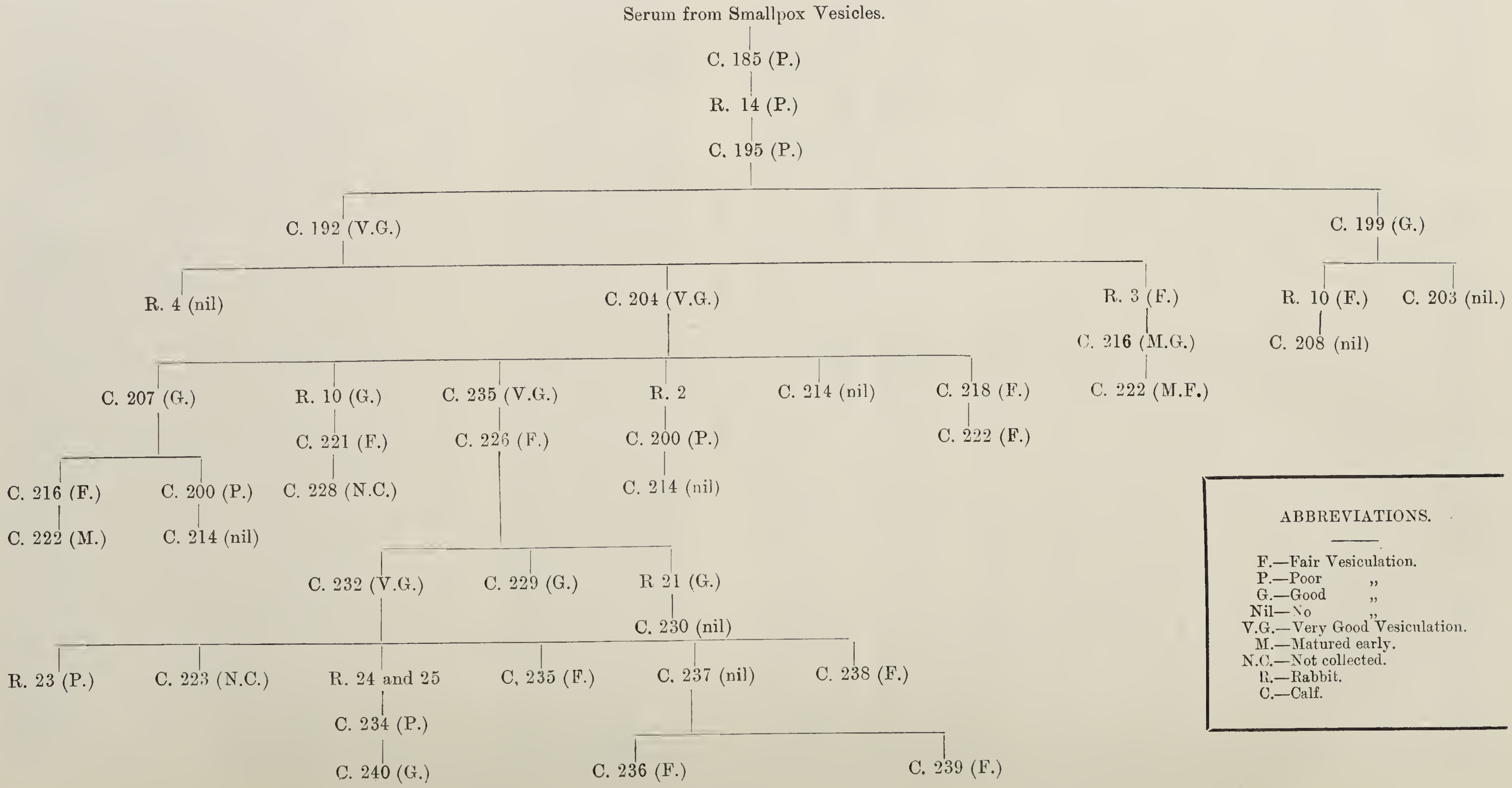
(*a*) The Supply of Calves.

Calves are obtained from the natives through the District Commissioner. They are supplied on the hire system, Sh. 10s. for the use of each calf. Should a calf die while in use in the Laboratory, compensation is paid at the rate of Sh. 150s. per calf. These prices were fixed by the District Commissioner.

As far as possible the calves are selected, white heifers from six to twelve months old with unpigmented abdomens being taken. There are many difficulties, however, for the natives object to their calves being used for vaccination, East Coast Fever was prevalent in the district of supply throughout the year, and the calves were usually in poor condition when brought in owing to the scarcity of food due to the drought. On a good many occasions the majority of calves offered were quite unsuitable for vaccine purposes; but had to be used to keep up the supply of calf lymph.

TABLE I.

ZANZIBAR LYMPH STRAIN.



ABBREVIATIONS.

F.—Fair Vesiculation.
P.—Poor ,,
G.—Good ,,
Nil—No ,,
V.G.—Very Good Vesiculation.
M.—Matured early.
N.C.—Not collected.
R.—Rabbit.
C.—Calf.

It is hoped that when the refrigerating plant is erected during the coming year, these difficulties will be largely overcome, as it will then be possible to obtain calves when the grazing is at its best, so that there will probably be fewer failures and so fewer calves will be necessary.

(*b*) Housing of Calves.

During the second half of the year calves waiting to be vaccinated were kept in a shed in the Quarantine Hospital, and grazed over the surrounding plains. While there, they were dipped twice a week in the municipal dip. Notwithstanding this, 15 calves died during the year of East Coast Fever.

Several alterations were made in the calf shed in 1921.

(1) Two sets of floor boards were made for each stall.

(2) Wooden gates, having a space between sufficient for a calf's neck to move up and down in, were put up in each stall.

(3) Hay racks were provided in each stall.

(*c*) Feeding of Calves.

The calves were fed on crushed maize and fresh grass. Cocoanut oil-cake has been tried, but has not proved very satisfactory as the calves are not kept in the Laboratory long enough to become accustomed to a strange food.

(*d*) Preparation of Calves for Vaccination.

The calves are brought down to the Laboratory three to four days before being vaccinated. They are thoroughly washed and groomed and kept in the waiting shed. The evening before vaccination their abdomens are shaved. The Belgaum method of applying glycerin after shaving was tried for a while, but did not seem to give any advantage, so it has been stopped.

(*e*) Vaccination of Calves.

The calves are placed on the operation table and the shaved area thoroughly washed with soap and water. The abdomen is then sprayed with sterile water, and dried with sterile swabs. Vaccination is performed with a scalpel. The incisions are made about 6 inches long with an average number per calf of 36. Three incisions are made at a time and the seed lymph inserted with an instrument made locally for the purpose. It is six inches long and made of polished steel, tapering to a point, the end being ball-shaped and having a diameter of $\frac{1}{16}$ of an inch. Three grooves are cut above the ball-shaped end running in the long axis of the instrument. When in use the sterile vaccine inserter is dipped into the vessel containing the seed lymph and applied along the incision, the grooves in the steel retaining enough lymph to inoculate one incision.

(*f*) Care of Vaccinated Calves.

During the first part of the year, aprons were used on the calves to protect the vaccinated area, but when the floor boards and gates were made, aprons were discarded as unnecessary. With native attendants only, it is very difficult to keep aprons clean, and if a calf wears a badly soiled apron all night the result on the vaccine pulp is worse than if no apron had been in use. The floor boards are taken out every morning at 7 a.m., scrubbed and left in the sun for the day and the duplicate set put in the stall. At 4 p.m.

these boards which are now soiled are taken out and cleaned, and replaced by the dry boards cleaned in the morning. A boy is on duty all day to keep the floor-boards in use clean, and the sheds are inspected at night by the head boy.

The vaccinated area is inspected daily, and when the vesicles are mature the lymph is collected. This usually occurs after about 120 hours.

(*g*) Collection of Pulp.

The calf is put on the table, and the vaccinated area washed with sterile water and dried. The vesicles are inspected and their quality noted in the record book. Quality is classified as follows :—

(1) + + + + Lines of vesicles unbroken and with a straight margin.
(2) + + + Lines of vesicles unbroken but with a wavy margin.
(3) + + Lines of vesicles with indented margins and also discrete vesicles.
(4) + Discrete vesicles only.

First quality vesiculation is rarely seen, probably because the calves used are not sufficiently healthy.

Second quality vesiculation is fairly common.

Third quality vesiculation is commonest.

Fourth quality vesiculation is collected only when the vesicles are in fair numbers and of healthy appearance.

The lines of vesicles are removed with a Volkmann spoon, care being taken to remove the base. The pulp is placed in sterile Petri dishes and labelled with the calf's number. The collection of pulp from each calf is kept separate, and retains its individuality when made into lymph.

TABLE II.

(*h*) Results of Calf Vaccination.

No. Vaccinated.	No. Successful.	No. Failed.	Average Yield.	
			For each calf successfully vaccinated.	All Calves.
226	91	135	grammes 12·3	grammes 4·3

The results for the first six months were very poor. The seed lymph was not good and the calves were not in good condition..

With an improved seed lymph, the yields became much better in quantity and quality of vesiculation, especially the latter. White calves and calves with unpigmented abdomens gave very much better vesiculation than black or grey calves. This was most evident when a calf with a partly pigmented abdomen was vaccinated. The vesiculation on the non-pigmented areas, especially near the groin, was often very good. On the portions of the incisions on the pigmented skin the vesicles were poor or absent.

Some large yields were obtained during the last six months of the year, the largest being 27·8 grammes, and yields of 12 to 20 grammes were very common. When the vesicules were of good quality, the lymph gave good vaccination results, the insertion rate and the success rate being almost equal, so that the quality of the vesiculation is the real determinant of the value of the vaccine, and a large yield does not necessarily imply a lymph poor in taking properties.

The number of failures was large, and while the condition and colour of the calves and the quality of the seed lymph account for many of these, they do not explain all the failures. Sometimes several apparently suitable calves would be vaccinated with the same seed lymph on the same day, and while one or two of the calves gave very good vesiculation, the others failed. The reason for this is not understood at present.

(*i*) PREPARATION OF THE EMULSION.

The sterile Petri dishes containing the pulp are brought to the weighing and grinding room. The weight of glycerin solution used is four times the weight of pulp, and is a mixture of equal parts of pure glycerin (Burgoyne and Burbridge's Glycerinum pur. S.G. 1·260), and distilled water titrated to Ph. 7·4 by a colorimetric method of hydrogen ion concentration estimation.

The pulp is ground with the glycerin solution by passing it three to four times through a Chalybæus machine (Blaxall's modification). The glycerin and pulp are placed in the hopper of the machine in small quantities until all has been ground. The resultant emulsion is passed through the machine again and again until it is judged to be thoroughly ground and mixed.

(*j*) STERILIZATION OF THE EMULSION.

Three methods have been tried during the year.

(1) *Blaxall's Clove Oil Method.*—0·1 per cent. clove oil was added to the 50 per cent. glycerin solution in distilled water. The results were uncertain, large numbers of organisms frequently being present even after a month's storage. As the lymph could not be retained sufficiently long to obtain its sterility, the method was discontinued. Another difficulty encountered in this method was the thorough mixing of so small a quantity of clove oil with a liquid like glycerin. The latter trouble could be overcome by mixing the clove oil and glycerin in bulk.

(2) *The Glycerin was Diluted with an equal quantity of Chloroform Water.*—This method gave very satisfactory results as regards removal of extraneous organisms, but it is believed that the lymph suffered in activity. The number of organisms always fell below ten per loopful in fourteen days to three weeks and shortly after this the lymph was invariably sterile.

(3) *The Belgaum Chloroforming Process.*—This is described by Fisher in the Indian Journal of Medical Research for October, 1920. This process was first used in August, 1921, and the results have been very satisfactory. The lymph is ready for issuing within a week of removal from the calf and apparently remains active for a long period. It has the great advantage of removing the majority of the extraneous organisms with very little, if any, loss of activity of the lymph, probably because the disinfectant is completely removed immediately, and so does not remain in contact with the lymph virus, as was pointed out by Fisher. This is the method at present in use in the Laboratory.

The procedure employed is as follows :—

A water blast pump is used to produce the necessary current of air which first passes through an empty Woulff bottle, then through a glass tube containing cotton wool, and then into a Woulff bottle containing chloroform (Duncan and Flockhart's). Chloroform vapour and air then pass through a bottle containing sand sterilised in a hot-air oven for three hours at 110° C., which removes any moisture, and from thence the vapour passes through the lymph which is contained in the large test tubes. The whole apparatus, with the exception of the sand bottle, is sterilised in an autoclave. Chloroform vapour is bubbled through the tubes of lymph for twenty minutes to half an hour, the time depending on the quantity of lymph. The chloroform and sand bottles are now removed and air only is bubbled through the lymph for three hours, the tubes after the first fifteen minutes being kept in an ice box at a temperature of about 8° C.

On completion of the sterilising process the lymph is transferred to smaller sterile tubes, and a loopful is planted out on an agar slope, after which the tube is corked with a sterile rubber bung and the top paraffined.

The number of colonies on agar per loopful immediately after chloroforming vary from 4 to 40 and within a week the colonies are almost always below 10 per loopful. Before issue each batch is examined for Bacillus tetanus, using an anærobic stab culture in glucose agar, and for ærobic pathogenic organisms. Lymph batches in stock are tested by planting out on agar slopes every week and they remain almost sterile.

(*k*) Bacteriology of Lymph.

Ærobic and anærobic cultures were made at regular intervals. B. tetanus was never found. The main organisms seen were :—

(1) Staphylococcus albus—the commonest.
(2) Staphylococcus aureus.
(3) A Gram positive bacillus resembling B. subtilis.
(4) Rarely a Gram negative bacillus non-pathogenic to guinea-pigs.

(III)—LABORATORY VACCINATIONS.

(*a*) Source of the Material.

268 persons were vaccinated in the Laboratory and used to control the activity of the lymph before it was issued to the various stations. This number was made up as follows :—

224 Police from the Police Depôt.
37 Staff and patients of the Infectious Diseases Hospital.
7 others.

Through the courtesy of the officer in charge of the Police Depôt, 12 police were sent to the Laboratory every Saturday. They came with unfailing regularity, and without the co-operation of this officer the satisfactory control of lymph activity would have been impossible.

(*b*) Routine.

The Police were vaccinated on Saturday morning and seen again on Tuesday and again on the following Saturday. Each batch of lymph was used to vaccinate several men before issuing, and if not active after several vaccination tests the batch was discarded.

Unfortunately out of the 244 men vaccinated, only 19 had not been previously vaccinated, while a few were doubtful. The remainder had been vaccinated before, the majority of these several times. Notwithstanding this the number of vaccinated cases which were completely unsuccessful was only 44. Twelve were not seen again after vaccination.

The value of seeing the vaccinated on the third day was very evident. Some men who were revaccinated, showed on the third day an accelerated reaction with rows of very small but very distinct vesicles along the lines of scarification, but in 75 cases these vesicles had completely disappeared by the eighth day, although other men vaccinated on the same or a later date with the same lymph and under the same conditions had well-formed vesicles on the eighth day and gave a typically successful result. Three months later several of these men whose vaccination had aborted were again vaccinated with active lymph and all failed completely. The explanation may be that where a partial immunity already exists the reaction is accelerated and nothing can be seen after the fifth or sixth day, for no signs of the slight vesiculation remain and if the men had not been seen on the third day it would not have been suspected. This abortive vaccination, though very interesting, made it difficult to gauge the activity of the vaccine lymph. If there was any doubt about the activity of a lymph batch it was not issued until a control gave four areas of well-formed vesicles as the result of four insertions of lymph in four separate areas on the arm or leg.

(*c*) TECHNIQUE OF LABORATORY VACCINATIONS.

(1) The arm was scrubbed with soap and water, all soap removed with fresh water, and the arm allowed to dry.

(2) Ether was sometimes used to clean the arm after washing, but was not employed as a routine measure, as it was considered desirable to vaccinate as far as possible under the same conditions as in an out-station where several hundred people might have to be dealt with in a day.

(3) Straight surgical needles, No. 1 size, were used for making incisions. Each needle was boiled after use, and placed in a small dish containing sterile water. The lymph was inserted with the rounded end of a King scarifier. Four sets of scarifications were made 1 inch apart. Each set was made up of four incisions, $\frac{1}{6}$-th inch long and $\frac{1}{16}$-th inch apart. The needle was held perpendicularly to the skin and the skin sharply incised till the moist pink surface of the cutis vera was visible. Blood was not drawn. The needles were kept very sharp as it is essential that the edges of the incision should be injured as little as possible. No covering was employed, the men being kept indoors until the lymph had dried on the arm completely.

(*d*) POLICE VACCINATION RESULTS.

Number vaccinated	244
3rd day.	
Number showing small well-formed vesicles ...	114
Number showing very slight vesiculation or slight reaction	49
No. showing no reaction	46
Number not seen	11
Total ...	220

8th day.	
Successful vaccinations	67
Poor vesiculation	23
Abortive vaccination (*i.e.*, vesiculation on the 3rd day, nil on 8th day)	75
Failures (no reaction seen on 3rd or 8th day) ...	44
Number not seen	11
Total ...	220

Twenty-four police were vaccinated by the intracuticular method. On the third day 21 showed a reaction consisting of slight swelling, tenderness and vesicles at the point of innoculation, 2 were doubtful, and 1 was not seen.

On the eighth day some showed vesiculation and swelling, others nil. Three of these men were vaccinated six weeks later by the ordinary method and gave negative results.

(*e*) OTHER VACCINATIONS.

Thirty-seven of the staff and patients of the Quarantine Hospital were vaccinated.

TABLE III.

No. Vaccinated.	Successful.	Failed.	Not Seen
37	17	12	8

(IV)—STORAGE AND DISPATCH OF LYMPH.

(*a*) STORAGE.

Lymph is stored in the Laboratory in an ice chest, the temperature of which varies from 8° C. to 18° C., depending on the number of times the chest has to be opened during the day. The lymph remains active in the ice chest for several weeks, the time depending on the initial quality.

A new ice chest was made in July. The former ice chest was very old and the temperature rarely fell below 16° C. Lymph was stored in it in Erlenmayer flasks with a cotton wool plug and a large quantity of it had to be destroyed in April, May and June, owing to fungus contamination. The lymph is now stored in large test tubes with a rubber bung, and is filled within one inch of the top, and the bung paraffined. Owing to this and also to the fact that the temperature of the new ice chest is lower than that of the old, no lymph has been contaminated with fungi since July. Lymph is issued as a rule after three to six weeks' storage.

(*b*) FILLING OF LYMPH INTO CAPILLARY TUBES.

All lymph is dispatched in capillary tubes, each tube holding sufficient to vaccinate three persons.

Five c.c. of lymph are taken out of each batch before filling and kept in the Laboratory for reference, in the event of any unsatisfactory reports being received. The remainder is poured into a sterile beaker and a modification of Entrican's machine used for filling, viz., a Bruhl's jar through the lid of which a rod moves in a verticle direction. To this rod the capillary tubes (sealed at the upper end) are hung in a bundle kept together by two rubber bands. Lymph is placed in a vessel in the jar below the tubes. The jar is exhausted with a Geryk vacuum pump and the tubes then lowered so that their open ends dip into the lymph. When air is admitted into the jar the lymph rises into the tubes. The sealing of the tubes is done with a spirit lamp, one tube at a time, and the tubes are immediately put on ice.

(*c*) METHODS USED FOR DISPATCH OF LYMPH.

(1) *Packing in Wooden Boxes with Ice and Sawdust.*—This is very satisfactory if the distance the lymph travels is not too great.

(2) *Thermos Flasks.*—The great difficulty with Thermos flasks is that they are so easily broken unless carried by hand. The capillary tubes of lymph are put in test tubes, each tube holding fifty to sixty capillary tubes. The test tubes are then put into the flask and firmly packed with sawdust and ice. The flask is put into a wooden box having a thick pad of felt at the bottom, a spring round the sides lined with felt, and a sliding lid. Practically every flask sent out got broken during its first or second journey. Packing boxes in a basket, well padded with tow, was also tried in the hope that the padding would absorb some of the shock, but the two boxes send out in this way also got smashed. At present a box is being made with well-padded sides and a spring at the bottom and on the lid which hinges over and is strapped down. It is hoped that this will prove more successful.

All lymph for the Nyanza Province is sent to the Medical Officer of Health, Kisumu, who sends supplies when required to Kakamega and Kisii. It is kept in an ice box in Kisumu until dispatched. Similarly the Medical Officer of Health, Mombasa, distributes lymph to Kismayu, Lamu and other stations.

(V)—DRIED LYMPH.

(*a*) Locally Manufactured Dried Lymph.

This was issued to Lamu and the Frontier Stations during the first six months of the year. The lymph was put up in ampoules in vacuo. A large number of ampoules were broken in transit and the lymph lost. Glycerinated lymph is now being sent to all stations.

(*b*) Blaxall's Dried Lymph with Myrrh.

Dried lymph with myrrh was sent out from England via South Africa by Dr. Blaxall in single and double vacuum tubes. The lymph travelled in an ordinary cabin trunk and was two months in transit. Several tubes arrived broken. On arrival four police were vaccinated with lymph from both single and double vacuum tubes. Two of the four police were vaccinated as follows :—

Two scarifications were inoculated with Dr. Blaxall's lymph and two with stock lymph. No vesiculation occurred with the dried lymph and myrrh in any case. In one of the controlled cases one poor vesicle developed on the third day with stock glycerinated lymph. The second case showed two good vesicles with stock glycerinated lymph. The results from Dr. Blaxall's lymph was nil. One calf was vaccinated from the dried lymph. The calf was light brown in colour, about 12 months old, and in fair condition. One-half of the abdomen was vaccinated with dried lymph from a single vacuum tube, and the other half with dried lymph from a double vacuum tube. Both failed completely.

All other patients and calves also gave no result with vaccination with the dried lymph, so that it may be concluded that the dried lymph on arrival was inactive. It should be noted that no special precautions were taken to protect the lymph from heat, and the test to which it was subjected was therefore a severe one. It is hoped that experiments on the transmission of dried lymph, and its power of retaining activity, will be continued during the coming year.

(VI)—VACCINATION RETURNS.

(*a*) LABORATORY ISSUES OF CALF LYMPH.

Number of doses issued by Laboratory :—

(*a*) Glycerinated lymph	66,162 doses.
(*b*) Dried lymph	17,300 doses.
Total No. doses issued	83,462

The lymph was issued as follows :—

Kenya Colony and Protectorate ...	80,442 doses.
Zanzibar	2,820 doses.
Seychelles	200 doses.

(*b*) SUMMARY OF RETURNS RECEIVED.

This return is compiled from the returns sent to the Chief Sanitation Officer and from the Laboratory returns. (See Appendix II).

Kenya.

No. of doses issued	80,442
No. of persons vaccinated	58,909
Successful vaccinations	7,565
Unsuccessful vaccinations	3,700
Results unknown	47,644
Percentage case success rate	68 per cent.

Seychelles.

No report was received.

Zanzibar.

No. of doses sent	2,820
No. of persons vaccinated	2,046
No. of successful vaccinations	224
No. of unsuccessful vaccinations	1,400
Results unknown	422

(The unsuccessful results were among the re-vaccinated.)

Reports were received at the Laboratory for 47,206 doses issued. The fate of the remaining 36,256 doses is unknown. Only 11,265 people were seen after vaccination out of a total of 58,909 vaccinations. Re-vaccinations have not been distinguished from primary vaccinations in the reports, but the number must have been high, as the majority of those vaccinated were male adults going to work on various farms, the railway, etc.

The figure 68 per cent., taken as the case success rate, is misleading, as there is little doubt that considerable numbers of vaccination results reported are incorrect. The following are some copies of reports which give accurate information and from which some conclusions can be arrived at with regard to the activity of the lymph issued.

TABLE IV.

Report received from and date issued.	Doses issued.	Total No. Vaccinated.	No. observed on 8th day.	No. of successful vaccinations.
M. O. H. Mombasa. 25/7/21	300	290	250	240
M. O. H. Mombasa. 5/9/21	300	27	17	17
M. O. H. Mombasa. 13/9/21	300	56	30	22
Dr. Forbes, Magadi.	20	17	15 results.	15 excellent.
	Total ...	390	312	294

In these reports, 80 per cent. of those vaccinated have been seen, and the success rate is 94·2 per cent. In the returns from some stations the success rate is persistently low. Three factors may be involved in these cases.

(1) *Previous Vaccination.*—As a rule in the towns and stations the majority of the natives are vaccinated. It was very unusual to find an unvaccinated native amongst the police recruits seen in the Laboratory. The primary vaccinations as a rule came from out of the way parts of the Wakamba Reserve. The adult male Kavirondo population is largely vaccinated, as numbers of them were in the Carrier Corps during the war, and for many years all labour leaving the Nyanza Province has been vaccinated in Kisumu. A high percentage case success rate cannot therefore be expected from such material. The vaccinations performed during the year were mainly from—

(*a*) Station hands, prisoners, and natives employed by the Municipality, etc;

(*b*) Natives being registered in the Reserves;

(*c*) Labour going out to shambas.

Of these only the first group, which consists mainly of previously vaccinated individuals, was seen again by the vaccinator. Vaccination in the Reserves, except amongst adult males during registration, has not been carried on during the past year.

(2) *Faulty Technique in Vaccinating.*—This is an undoubted cause of failure in some cases. Some of the more obvious faults are :—

(*a*) The arm is washed with soap and water and the soap is not properly removed, leaving an alkaline deposit on the arm;

(*b*) Unnecessary damage is done to the skin when it is scarified, and this may lead to sepsis.

(*c*) Scarification may be too superficial or too deep;

(*d*) The lymph is rubbed into the scarifications with an instrument which recent sterilization has rendered too hot;

(*e*) The patients are allowed to stand with the vaccinated arm exposed to the sun before the lymph has dried.

(3) *Inactive Lymph.*—Although each lymph number is tested for activity before being issued, there are several fallacies, *e.g.* :—

(*a*) The capillary tubes containing lymph are sealed by African laboratory assistants and, although they are carefully trained and supervised, it is probable that a few tubes in a batch are over-heated. In filling the tubes, the lymph is drawn into them as far from the open end as possible, but all tubes are not equally filled, and with African labour it is impossible to ensure that an occasional tube is not inactivated;

(*b*) The pulp is made up of a certain amount of extraneous material as well as the actual virus, and it may be possible that some portions of the mixture are not as active as others, but this is unlikely as the mixture is passed through the Chalybæus machine several times. Furthermore, Dr. Duke, of Uganda, informed us that he had vaccinated with the clear supernatant fluid from lymph satisfactorily, and it has also been done here with positive results;

(*c*) The lymph may deteriorate in transit, especially to the more distant stations. The time taken on the journey is often considerable and the containers of the lymph tubes are frequently broken. This is probably the most prolific cause of ineffective lymph, and it is hoped that during the coming year experiments now in progress will eliminate this source of trouble to a very large extent.

(VII)—CALF LYMPH EXPENDITURE, 1921.

Total number of doses manufactured	223,300
Total number of doses issued	83,462
Total number of doses used as seed lymph	2,574
Total number of doses in stock	13,400
Total number of doses of the Zanzibar strain lymph manufactured before being suitable for issue ...	29,254
Total number of doses which became inactive or contaminated	94,710
Total expenditure on lymph production	£1,515 13s. 7d.
Cost per dose manufactured	1·63 pence.
Cost per dose issued	4·36 pence.

B—MALARIA.

The incidence of benign tertian malaria still shows the reduction noted in the reports for 1919 and 1920. A comparison of the figures for the last eleven years is instructive as showing the rise in incidence of this form of malaria compared with subtertian malaria during the East African campaign.

TABLE V.

	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
Benign Tertian Malaria ...	25	19	12	10	61	176	607	308	90	44	19
Quartan Malaria	13	13	4	10	22	27	11	7	12	10	4
Subtertian Malaria	238	209	174	218	814	655	881	435	540	224	83

As has been pointed out in previous reports, the rise and fall of the number of benign tertian infections coincides more or less closely with the arrival and departure of the Indian troops who took part in the campaign in this country. Why the infection has not persisted cannot be conjectured with our present knowledge except it be the withdrawal of a large body of reservoir hosts and it will be interesting to see whether a wet year will again increase the number of cases of benign tertian malaria beyond the normal proportion. It will be noted in connection with the weather conditions that the amount of malaria as reflected in blood slides diagnosed in the Laboratory is lower than it has been at any time in the period for which figures are given on p. 148. This is attributable to two factors. Firstly, the year has been one of great drought and comparatively few mosquitoes. Secondly, there has been an increasing tendency on the part of medical officers to examine and report on blood slides taken from their own cases, consequently the slides which have been sent to the Laboratory for diagnosis have been mostly those in which the medical attendant has been unable to find malaria parasites for himself. The relative importance of these factors in determining the low figure for malaria in the Laboratory records cannot be known until a wet season has been passed through and the effect of it on the malaria incidence noted.

A fact to which attention should be drawn is the very small number of subtertian crescent forms seen. Three out of the five cases found this year have been in patients who also harboured benign tertian parasites. Cases of subtertian malaria in which most of the red blood corpuscles are infected are uncommon at present.

One observation which may be of importance is that the blood slides from patients suffering from malaria and coming from the Thika district near Nairobi show plasmodia which conform in most particulars to the typical subtertian ring form but differ in having two large, coarse masses of chromatin which may be situated at opposite sides of the parasite, and in the ring being larger in size than is usual. These features are constant in all the parasites found in the same slide and almost so in the bloods of patients who have actually derived their infection from the district mentioned. It may be remarked that malaria in that district is notoriously of a severe type and is followed frequently by blackwater fever.

C.—SPIRILLUM FEVER.

The cases which were diagnosed in the Laboratory during the year were all natives and these were not dwellers in Nairobi. Most of them came from the Kyambu district and two were recent arrivals from Fort-Hall, which is known to be an endemic centre of the disease. An entomological survey of the country is urgently needed to determine the tick distribution as well as that of the mosquitoes. This might explain why spirillum fever is localised to a few scattered areas of very small size, and why no general outbreak of the disease followed the repatriation of military porters from German East Africa, many of whom undoubtedly returned infected with the Spironema vossi, and, having escaped diagnosis, went back to their Reserves, where, as far as we know at present, the same tick exists as in the districts where spirillum fever is endemic.

D.—HELMINTHIC INFECTIONS.

Comparatively few stools have been received for examination for the ova of helminths during the year. Here again there has been a greater desire on the part of the clinical staff of the hospitals to make their own examinations, and this has been encouraged by us since by the carrying out of such work by medical officers. the Laboratory staff is released for more specialised duties. Again infection with Ancylostomidæ heads the list, but it is doubtful if this really represents the true numerical relations of the various infections, for the Ancylostomidæ caused symptoms for which relief is looked for in hospitals earlier and more frequently than any other family of worms, hence in any statistics obtained from patients in hospital, the parasites which cause the worse symptoms will always be more prominent. It is only by the examination of a body of healthy natives such as are found in an Institution or a gaol, that the true proportion of infections with the various intestinal helminths can be found. Unfortunately it is again impossible to state whether the Ancylostomidæ whose ova were seen were Ancylostoma duodenale or Necator americanus, since only a small portion of the patient's stool was sent for examination, and apparently the whole stool was not examined at the hospital for worms after treatment. It is hoped to do something to elucidate this important question during the coming year. From helminths recovered from post mortem examinations and from the comparatively mild symptoms exhibited by patients apparently heavily infected, it is probable that the common infection will be found to be Necator americanus.

In 315 stools examined the following infections were found :—

Ova of Ancylostomidæ in 33 cases	10·5	per cent.
Ova of Tænia saginata in 30 cases	9·5	,,
Ova of Trichiuris trichiura in 26 cases ...	8·3	,,
Ova of Ascaris lumbricoides in 12 cases ...	3·8	,,
Larvæ of Strongyloides stercoralis in 10 cases...	3·2	,,
Ova of Schistosoma mansoni in 9 cases ...	2·9	,,

Double infections occurred in 25 cases = 7·9 per cent. They were as follows :—

Ova of Ancylostomidæ and T. saginata ...	6	cases.
Ova of T. saginata and T. trichiura	5	,,
Ova of A. lumbricoides and T. trichiura ...	4	,,
Ova of Ancylostomidæ and T. trichiura ...	3	,,
Ova of A. lumbricoides and T. saginata ...	2	,,
Ova of A. lumbricoides and larvæ of S. stercoralis	1	case.
Ova of Ancylostomidæ and larvæ of S. stercoralis	1	,,
Ova of T. saginata and larvæ of S. stercoralis ...	1	,,
Ova of Ancylostomidæ and A. lumbricoides ...	1	,,

Triple infections occurred in 2 cases = 0·6 per cent. They were as follows :—

Ova of Ancylostomidæ, A. lumbricoides and T. trichiura	1	case.
Ova of Ancylostomidæ, T. trichiura and larvæ of S. stercoralis	1	,,

Quadruple infection occurred in one case = 0·3 per cent. It was as follows :—

Ova of Ancylostomidæ, A. lumbricoides, T. saginata and S. mansoni	1	case.

Comparison of the figures for Schistosoma mansoni infections for the last three years shows that, although the actual number of cases observed has decreased, the percentage borne to the total number of stools examined for ova has steadily increased; thus in 1919 it was 1·8 per cent, in 1920 it was 2·4 per cent. and in 1921 it was 2·9 per cent. of all specimens investigated. The figures, however, are not sufficiently large to justify any conclusion as to the increase or otherwise of the prevalence of this infection amongst the population. It is hoped to continue investigations into the presence of infected snails in the various local waterways during the coming year. It is worthy of note that rectal bilharziasis is much more common in this country than the urinary type.

It is generally assumed that infection with Trichiuris trichiura causes no symptoms unless present in large numbers. One case that occurred in an European child during the year under consideration tends to disprove this statement. The child was anæmic, had a poor appetite and slept badly. Examination of the stools showed scanty T. trichiura eggs. Two doses of oil of chenopodium at ten day intervals resulted in rapid improvement of the patient and the complete disappearance of the ova from the fæces.

One point that may be of interest is that, in spite of the large number of natives who are found to be infected with intestinal parasites, the number of blood slides from Africans which show eosinophilia is very small. An investigation of the relation between eosinophilia and helminthic infection might well be carried out by a medical officer in charge of a gaol or similar institution.

E.- PSEUDO DIPHTHERIA.

Two cases occurred during the year which clinically gave all the symptoms of diphtheria. One of these patients was a child with dyspnœa so acute as to call for immediate tracheotomy. A thick membrane was found in the throat which in a smear showed an organism having long branched mycelial threads with budding forms, but no bacilli resembling those of diphtheria. This fungus after several subcultures was isolated in a state of purity. On Sabouraud's agar it gave a profuse creamy white growth. There was no liquefaction of gelatine, and in litmus milk the organism produced acid but no clot in seven days. It fermented glucose, lævulose, maltose and saccharose with the production of acid and gas, but with galactose only acid was formed in the later subcultures, although there was doubtful gas formation in the earliest subcultures. This is perhaps explained by Castellani and Chalmers' statement in their text book of tropical medicine that Monilia may lose some of the fermentative action on galactose after several subcultures. The fungus isolated from the case under discussion was not pathogenic to guinea-pigs. From a consideration of its actions on gelatine, milk and sugar broths and from its morphological characteristics, it is probable that this organism was Monilia tropicalis or a closely allied fungus in spite of its non-pathogenicity for guinea-pigs.

F.—LEPROSY.

A case of leprosy was seen whose arms were covered with bullæ, which on puncture exuded a thick dark brown fluid. Microscopical examination of smears made from this fluid showed it to contain large masses of Bacillus lepræ.

G.—WASSERMANN REACTIONS.

Early in the year the method previously in use in this Laboratory was abandoned and that described by the Medical Research Committee in their Special Report, Series No. 14, page 36, substituted with very satisfactory results. The main difficulty experienced in Kenya is to obtain complement of a sufficiently high titre. This seems to be associated with the similar difficulty experienced in obtaining sera of high agglutination titre by inoculation of rabbits. It was noticed that the complement worked better in cold weather than in hot, and the guinea-pigs are now kept for two days prior to the withdrawal of blood for complement in a cool chamber at about 17° C. This has resulted in a more powerful complement being obtained as a regular occurrence. A trial was given to Donald's drop method as applied to the Wassermann test. It was found that if there were a large number of sera to be examined the drop method resulted in a gain in speed and accuracy, but when the number of sera was small the gain was counterbalanced by the large wastage in hæmolytic serum, and complement that occurred, while graduated pipettes gave a result inappreciably different from a practical point of view.

Several opportunities have now occurred of testing the blood of patients who have just returned to the Colony from England and who have had a Wassermann test carried out shortly before leaving London. The results obtained here have shown practically complete correspondence with the English results.

H.—AGGLUTINATION REACTIONS.

It has been frequently noted in previous reports that Widal reactions are often negative even in cases which clinically are undoubtedly enteric fever. During 1921 a considerable amount of the time of the Laboratory staff was spent in the attempt to produce high titre immune sera for the typhoid-paratyphoid group of organisms. The attempt was finally successful but all the recommendations given by authors working in European laboratories were found to be inapplicable in Kenya. Thus it is stated that 0·5 c.c. of a killed 24-hour broth culture inoculated intravenously and followed on the fifth or sixth day by the same or a slightly larger dose, will usually yield a serum of adequate titre by the tenth or eleventh day. This and similar small doses were tried but never gave a serum with a higher titre than 1 in 10. The size of the doses was increased, and it was eventually found that three doses of 5,000 million bacteria from an agar culture emulsified in 2 c.c. of a 0·5 per cent. solution of carbolic acid in normal saline given at six day intervals produced a serum with a titre of about 1 in 2,000 ten days after the last inoculation. This failure of agglutinin production may have some bearing on the comparatively frequent absence of the Widal reaction in typhoid fever.

The result of a series of agglutination reactions against B. proteus X 19 carried out on 93 natives in the Native Civil Hospital, Nairobi, will be found in Appendix 3.

I.—DISEASES RESEMBLING TYPHUS FEVER.

An account by Dr. Clearkin of a series of cases with symptoms allied to a mild form of typhus fever will be found in Appendix 3.

J.—VACCINES.

The majority of the autogenous vaccines made during the year have been from organisms of the B. coli group for conditions usually described under the term "rheumathoid arthritis." In Appendix 4 will be found a note on the use of these vaccines and the results up to date, and from this it will be seen that the hopes expressed in the annual report for 1919 have been justified. This year the diseases for which the vaccines have been found useful have been extended and it now remains to discover the extent to which infection with the organisms of the coli-typhoid group or absorption of their toxins from the bowel is responsible for definite pathological conditions and for those indefinite ailments best described as malaise.

Three cases of pyhorrhœa were treated with autogenous vaccines prepared from pus taken from pockets in the gum round the teeth. These vaccines contained a mixture of a staphylococcus, a short streptococcus and Micrococcus catarrhalis, and the result of the inoculations combined with dental treatment was apparently a complete cure in each case.

T.A.B. vaccine was manufactured this year from bacteria grown on agar slopes and emulsified in a solution of 0·5 per cent. carbolic acid in normal saline instead of from broth cultures as was done previously. The result has been most satisfactory, for the local reaction following inoculation is much diminished.

K.—WATER SUPPLIES.

Twenty-six waters of various kinds were examined during the year. This is a considerably smaller number than in former years and is due to the paucity of the Laboratory staff, which resulted in waters being crowded out by more important work from February to July, and to only one soda water being submitted by the Health Officer for examination. An examination of the water supply of the British East Africa Fibre Company factory at Masongaleni was carried out in August. The source of this supply is the Kibwezi River, which runs through the estate. The water is pumped from the intake up to the factory, which is about nine miles away, and is carried for this distance in iron pipes laid along the surface of the ground and so exposed to the sun. As Masongaleni has a tropical climate the temperature of the pipes is high, but as the water is in constant circulation during the heat of the day, since it is in continual use in the factory processes, the effect of this heat on the water must be comparatively small. It will be noted that the water in the tanks at the factory itself, as seen in samples 137 and 138, is somewhat better than the river from which it is drawn. As, however, only one sample was obtained from each place, no definite deductions can be drawn from the results, except that as the sourse or the supply is open to contamination by human beings, it is a dangerous one, a conclusion borne out by the only bacteriological examination done. It was advised that some method of water purification should be carried out.

The results of the examination of the Nairobi water supply during 1921 in conjunction with those of previous years, can now be said to give sufficient figures to conclude that from the bacteriological point of view this supply is open to serious contamination at frequent intervals. The chemical analysis of the water over the same period does not show these periodical changes. The interpretation of these results is difficult. The following data are the only ones available from which to draw conclusions as the result of examinations made up to the present time :—

1. The reservoir at Kikuyu holds a three-day supply of water for Nairobi at the present rate of consumption, and has a capacity of about two million gallons.

2. The reservoir is fed by thirteen accessible springs of a comparatively small volume, and two inaccessible springs of comparatively large volume opening into the lower half of the reservoir.

3. There is a defective collecting drain around the reservoir to arrest surface water.

4. There seems to be a slight correlation between the rainfall and the B. coli count, but the rise in the latter figure does not take place till there has been continuous heavy rain for ten to fourteen days. The rainfall statistics are supplied by a non-European station-master at Kikuyu and are therefore open to question as to accuracy, so that this correlation cannot be stressed, especially as the examinations cover a period of time when the average rainfall has been considerably below the normal.

5. Examination of the accessible springs shows that on one occasion at least the water that they poured into the upper half of the reservoir is of passable purity.

6. On the one occasion on which it was possible to examine the water in the surface water collecting drain, its condition was not much worse than that of the water in the lower half of the reservoir.

7. There is a swamp on the other side of the hill to the reservoir which is 112 feet above the level of the water in the latter, and it is possible that this may connect with one or more of the springs by a fault in the strata.

8. The Nairobi water from the bacteriological point of view shows periodical and serious contamination, although the chemical examination reveals no change and so far no outbreak of water-borne infectious disease has been directly and unmistakably traced to the consumption of Nariobi water.

The contamination of the Nairobi water supply may occur in the reservoir, in the distributing tanks at Nairobi, or in the water mains. The result of several examinations made simultaneously at these various points shows, however, that the water as delivered in Nairobi does not differ appreciably from that in the lower half of the reservoir. and we must therefore conclude that the contamination occurs at Kikuyu.

Several possibilities present themselves to account for this.

Firstly, the contamination may arise from the access of surface water to the reservoir owing to the defects in the collecting drain. As in two places the hillside leading down to the reservoir has been cut away so as to allow water trickling down from the cut surface to collect in a pool at the base of the cliff, and as the water so obtained has been taken by a pipe from the pool across the surface water collecting drain directly into the upper half of the reservoir while no attempt has been made to prevent surface water gaining access to the pool, the real object of the drain surrounding the reservoir seems to be to persuade sightseers that the reservoir is adequately protected without interfering with the collection of as much water as the valley can possibly supply either by the springs arising in it or by the surface drainage from the hillside. As on that hillside there is a horse boma, whether used or not now I cannot say, and also a farm, this seems on the face of it the most probable source of contamination of the reservoir. Two difficulties stand in the way of accepting this explanation. In the first place the solitary examination of the surface water in the drain showed a count not much worse than that of the lower half of the reservior itself. If this is true of the surface water as a rule, one can only conclude that the various springs entering the reservoir are pouring in water almost as bad as that draining from the hillside, for otherwise the bacterial content of the surface water would be so diluted by pure water from the springs, that the count of the lower half of the reservoir would be considerably better than that of the water in the drain. In the second place if the access of surface water were the cause of the contamination, there should be greater correlation between the rainfall and the periods during which the water in Nairobi is impure, and one would expect that the time of greatest impurity would be immediately after heavy rain had washed down the accumulated filth of the dry season from the hillsides.

Secondly, the contamination may arise in the accessible springs supplying the upper half of the reservoir. This is again unlikely in view of the fact that the volume of these springs is comparatively small and the water they supply would therefore have to be very foul to contaminate the total flowing into the reservoir. Furthermore, on the occasions on which the water from these springs has been tested, the results show that the water is certainly no worse than that reaching Nairobi, and if anything, better.

Thirdly, the contamination of the reservoir may arise through the medium of the springs entering at the bottom of the lower half of the reservoir. This seems to be the most probable explanation of the facts given above, if we postulate that in normal times the water from the deep springs is adequately filtered by passage through a sufficient depth of soil, but that on occasions the water from these springs becomes very impure, probably as a result of a rise in the level of the ground water leading to a direct communication between the springs and a neighbouring body of water liable to contamination such as the swamp, by means of a fault in the strata.

Before the drawing of any conclusions is justified, the following investigations should be carried out :—

1. A geological survey to determine the existence of faults or cracks in the strata intervening between the reservoir and the swamp.
2. A test carried out during a period of contamination of the reservoir, to determine the possibility of water from the swamp reaching the reservoir.
3. Daily examination of the Nairobi water supply, the accessible springs at Kikuyu and the two halves of the reservoir over a period which includes part of the dry season and part of the wet season.

There can be no doubt that from the standpoint of the sanitarian the reservoir is inadequately protected from the access of surface water, and that a very considerable improvement in the quality of the water would be effected by covering over the lower half of the reservoir to exclude light and thus doing away with the growth of algæ, which prevents the present method of chlorination being effective from the bacteriological point of view. If this roofing of the lower half of the reservoir were carried out, the surrounding catchment drain made completely water-tight, the upper half of the reservoir excluded as a means of collecting and storing water, and those accessible springs which passed bacteriological tests over a sufficient period, piped from their exit direct to the lower half of the reservoir and adequately protected at their origin from the access of surface water, then bacteriological examination of the water would show fairly clearly whether the deep springs were subject to contamination or not, and if it were found that they were, then chlorisation of the water could be easily and effectively carried out at a much smaller cost than at present. The recommendation contained in the 1919 report that the fence around the enclosed area of the valley should be carried back to the crest of the hill still needs to be carried into effect, though if the reservoir is completely closed in, the necessity of doing this is not so great as under present conditions.

L.—THE HAEMORRHAGIC SEPTICAEMIA GROUP OF DISEASES.

An outbreak of pneumonic plague occurred early in the year, but it is impossible to report on the exact number of cases which showed the Bacillus pestis in the sputum, as this organism was confused with another gram-negative bipolar staining bacillus which closely resembled it in the first sputa sent to the Laboratory. The 42 slides seen and reported on as positive are therefore returned in Appendix 1 under the heading " Bacilli resembling B. pestis." Of these, 25 were undoubtedly cases due to this bacillus which resembles B. pestis, 7 were diagnosed before the recognition of this organism, and 10 were true B. pestis infection.

The confusion caused by the similarity of the two bacteria was increased by the onset of the disease closely simulating that of plague, in that there was sudden intense prostration, injection of the conjunctivæ, rapid weak pulse, cough with the expectoration of copious fluid sputum which was profusely blood stained. The temperature rose to 103 F. to 105 F. and some of the patients looked at the point of death. Slides of the sputa show innumerable gram-negative bipolar staining baccili. In the middle of a plague epidemic such cases justified a diagnosis of plague.

Had the subsequent course of the disease conformed to that usual in plague, no question as to the correctness of the diagnosis would have arisen, but in the majority of the cases the temperature fell rapidly, usually reaching normal on the third day, and the patient made a rapid and complete recovery (see charts No. 1-6). Too many cases followed this course to allow the diagnosis to go unchallenged, and the Laboratory had to confess that on closer examination the bacilli in the sputum of these cases differed slightly morphologically from typical B. pestis in that they were smaller, more delicate and with a less rounded appearance. About this time a fatal case occurred in an European which clinically resembled plague. This patient had been exposed to infection with B. pestis as he owned a go-down at Thika into which grain had been received from a store in Nairobi where rats were found dead of plague soon afterwards. Rats began to die in the Thika go-down and the patient became suddenly ill a week after he had cleared out his store and handled dead rats. Death took place within twenty-four hours of the commencement of the disease. A lung puncture before death yielded a pure culture of a gram negative bipolar staining bacillus, which fermented lactose, maltose, saccharose, dulcite, lævulose and galactose with the production of acid and gas, formed acid only in glucose, and had no action on mannite and arabinose. In milk it produced acid and clot. On salt agar no involution forms were seen and no stalactite growths took place in broth covered with a layer of oil. The growth on an agar slope 24 hours old, when emulsified in 2 c.c. of normal saline and injected intraperitoneally into a guinea-pig, was non-pathogenic. For these reasons the conclusion was drawn that the organism was not Bacillus pestis.

One other case occurred about this time. This was a man with gonorrhœa who developed a bubo. When this burst he sent a slide with a smear of the pus into the Laboratory. When examined this pus showed a heavy infection with the gram-negative bipolar straining bacillus described above.

Since this outbreak occurred at the commencement of the year no further cases have been seen. It is difficult to believe that a contaminative organism would have occurred only in these cases, all of which, except the one with the bubo, showed similar symptoms, and that its disappearance from smears of pus sent into the Laboratory should coincide with the cessation of these pseudo-plague cases. The matter needs further elucidation, and for the present we can only include the bacillus in the Pasteurella group of organisms. As it grew on bile salt neutral red agar containing mannite, galactose, glucose or lævulose, it cannot be placed in the animal sub-group of these organisms. Its non-pathogenicity to guinea-pigs excludes it from the plague sub-group, so that it would seem to form a special sub-group. Its importance lies in its liability to be mistaken for B. pestis in a smear.

An incident occurred during the campaign in East Africa on which the above observations throw some light. A draft of native troops was sent to Dar-es-Salaam from Nairobi, but on the voyage from Mombasa cases of illness occurred that from the examination of the sputum were diagnosed as pneumonic plague. The ship was duly quarantined at Dar-es-Salaam and further cases appeared among the contacts. The attention of the medical authorities was, however, drawn to the large percentage of recoveries, and Major Clemasha, I.M.S., who investigated the question, came to the conclusion that the disease was not true plague. A similar case occurred at the Carrier Hospital, Nairobi, at the same time as two fatal cases of septicæmic plague. The sputum of this case was swarming with gram-negative bipolar staining bacilli resembling very closely B. pestis. The man, however, recovered in a few days, and with our present knowledge, it is probable that this case should be classed as the same disease as that described above. Some time later plague was reported among some carriers at Dagoretti from the examination of a blood smear sent in to this Laboratory from one of the sick. Two of these carriers died from pneumonia but others with pneumonic symptoms, including the man whose blood showed so-called B. pestis, recovered in a very short time. Presumably there were also examples of this pseudo-plague disease, as no other cases of plague were reported from this district at this time, and no mortality was seen amongst the rat population.

M.—DIFFERENTIAL LEUCOCYTE COUNTS.

In Appendix VI will be found a table showing the results of differential leucocyte counts carried out during the year. The difference in the total shown in Appendix I under this head, and the total of cases in Appendix VI is represented by blood slides sent in for a differential count, which were found on the conclusion of the count to contain too few leucocytes to justify a numerical report.

Inasmuch as the blood slides recorded in the table were sent in from cases of pyrexia, and no history or list of symptoms accompanied them, it is impossible to judge the significance of the counts at this date, especially as no record of the eventual diagnosis has been kept. It is interesting to note that polychromes appeared as often in cases with as in those without a relative increase of large mononuclear leucocytes. This, together with the frequency of an increase in the large mononuclear leucocytes shown in pyrexias during 1921, when malaria was notably less common than in previous years, tends to throw doubt on the value of such an increase as evidence of malaria, although in one case showing gametocytes of subtertian malaria, the large mononuclear leucocytes did indeed rise to 43 per cent. of the total white blood corpuscles.

It is also worthy of note that a European child with a rectal infection of S. mansoni, gave a count of eosinophile leucocytes of 10 per cent. of the total white blood corpuscles. Several slides gave an increased polymorphonuclear leucocyte count. Most of these were cases of pneumonia or various septic diseases.

During the coming year it is hoped to obtain more facts about cases from which slides are sent in for differential counts, so that in our next report it may be possible to present data of some value in making such counts an aid to diagnosis.

N.—FRAMBŒSIA OR YAWS.

From the Laboratory point of view, little can be written on this subject, as the investigations carried out are limited almost entirely to a visit of one of the Assistant Bacteriologists (Dr. Allen) to Kisii, where he was enabled to see cases as they came in from the Reserves to hospital for treatment. This visit was made towards the close of the year, so that as most of the time in Kisii was spent in obtaining material to bring back to the Laboratory for more leisurely examination, the actual investigations were not concluded before the year ended, and so much must be left for next year's report.

A detailed examination was made of 33 cases, of which 31 were diagnosed as yaws. Only four cases were seen which could be described as tertiary yaws, and one of these left the hospital before any examination could be carried out. Each patient was closely questioned and as accurate a history of the illness obtained as was possible. A blood slide was then taken, and also blood withdrawn for a Wassermann test. (This was allowed to clot, and after standing the exuded serum was drawn up into a sterile glass capsule.) Lesions which appeared typical were then selected in each case, and after careful removal of the crust, and cleansing of the ulcerated surface with absolute alcohol, the serum exuded by pressure on the base of the lesion, was spread on glass slides. In four cases smears were also made from the crust on the lesion, a scraping from the granulating surface, and from serum drawn up by capillary attraction into a fine capillary tube passed through sterilised sound skin into the base of the lesion. It may be stated here that S. pertenue was not found either in the crust on the lesion or in the base thereof in any case. An attempt was made to examine the serum by dark ground illumination at Kisii, but the source of light was not sufficiently powerful to enable this method of diagnosis to be carried out satisfactorily. A simple smear of the serum was made in each case, and in some cases smears were made by the Indian Ink method.

In four cases lesions were excised, and placed in a suitable fixative for examination at a later date in Nairobi.

Dr. Allen carried out differential leucocyte counts on all blood slides made, and also examined the smears of serum from the lesions. Smears made by the Indian Ink method were examined immediately, while the simple smears were stained by a modification of Fontana's method, as follows:—

1. Fix for five minutes in—

Acetic Acid B.P.	1 c.c.
Formalin (40 per cent. formaldehyde ...	20 c.c.
Distilled water	100 c.c.

2. Wash with water.
3. Wash with absolute alcohol.
4. Flame off the absolute alcohol.
5. Pour on a solution consisting of—

Tannic Acid	5 gms.
Carbolic Acid 1 per cent. solution in distilled water	100 c.c.

and heat gently for half a minute.

6. Wash the film with distilled water.
7. Pour on a solution consisting of 0·25 per cent. solution of silver nitrate to which a solution of ammonium hydrate has been added till the precipitate which first forms is almost but not quite redissolved.
8. Wash in distilled water, dry and examine.

On the whole the Indian Ink method gave unsatisfactory results and with it there was always some difficulty in diagnosing the various spironema. The modified Fontana method gave a positive result in 20 cases out of 28 in which it was used, and in only one case was the smear negative by the Fontana method and positive by the Indian Ink method. The latter gave positive results in 13 out of 30 cases in which it was employed, and in 12 cases it gave a negative result when the Fontana stain gave a positive one. On these results it would seem that the Fontana method was the more reliable, but too much stress cannot be laid on this as further smears were not taken when one method showed that S. pertenue was present.

Thirty-one sera were brought down to Nairobi from these patients and a Wassermann test performed on them. All the sera but one arrived in an uncontaminated condition. The results of the tests as given by the fourth method of the Medical Research Committee were as follows:—

Of 30 sera examined, 24 or 80 per cent. gave a + + reaction.
,, ,, 4 ,, 13·3 ,, ,, +± ,,
,, ,, 1 ,, 3·3 ,, ,, + ,,
,, ,, 1 ,, 3·3 ,, gave a negative reaction.

The lesions which were excised and brought to Nairobi for histological examination have not yet been investigated. The results of such examination will appear in next year's Annual Report.

A synopsis of the cases showing the history, site of lesion, presence or absence of spirochætæ, Wassermann reaction, and differential leucocyte count will be found in Appendix VII, to which reference should be made for further information. The number of cases examined is too small to justify any conclusions being drawn from the differential blood counts. It will be noted, however, how rarely the primary lesion is situated on the genital organs, and that young children exhibit primary yaws as well as adults.

Photographs of several of the cases will be found attached.

APPENDIX I.

	Human.																			Cat.	Dog.		Guinea Pig.	Horse.		Rat.	Ox.			Various.		
	Blood.	Cerebro-spinal Fluid.	Exudate from Bulla.	Exudate from Liver.	Exudate from Lung.	Exudate from Lymphatic Gland.	Exudate from Spleen.	Fæces.	Gastric Contents.	Hair.	Nasal Secretion.	Pharyngeal Secretion.	Pus.	Skin.	Sputum.	Ulcers (Secretion).	Urethral, Vaginal & Prostatic Secretion.	Urine.	Various Tissues.	Spleen Exudate.	Blood.	Skin.	Spleen Exudate.	Blood.	Skin.	Spleen Exudate.	Blood.	Exudate from Lymphatic Gland.	Spleen Exudate.	Water Supplies.	Milk.	Shaving Brushes.
Total Specimens Submitted	1612	24	1	6	98	85	121	307	2	2	6	10	39	1	638	17	264	125	25	2	190	3	1	2	2	3873	7	3	8	25	3	2
Enumeration of Erythrocytes and Leucocytes	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Differential Leucocyte Counts	113	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spleno-medullary Leucocythæmia	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Parasites Detected by Morphology or Staining Reactions.																																
Plasmodium vivax	19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plasmodium falciparum ...	83	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plasmodium malariæ	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plasmodium vivax and falciparum (crescents)	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plasmodium falciparum with crescents	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spirillum rossi	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Babesia canis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	86	...	...	...	...	...	...	...	...	...	...	...
Piroplasma bigeminum ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...
Theilcria parva	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...
Leishmann-Donovan Bodies ...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spirochætæ	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Treponema pallidum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Treponema pertenue	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Entamœba coli cysts	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Trichomonas intestinalis ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Monilia	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Microsporon	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sarcoptes	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
Bacillus anthracis	1	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...
Bacillus lepræ	...	...	1	...	...	...	...	...	...	...	2	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus pestis	...	...	...	...	22	34	37	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	48	...	...	...	...	...	...
Bacillus resembling B. pestis...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	41	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus tuberculosis	...	...	...	...	1	...	...	...	...	...	...	...	...	...	37	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gonococcus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	49	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Meningococcus...	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pneumococcus	...	4	...	...	...	...	1	...	...	...	...	2	1	...	56	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Staphylococcus	...	...	...	...	...	1	...	...	...	...	...	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Streptococcus	...	...	...	...	...	...	...	...	...	...	...	2	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Ancylostomidæ	...	...	...	...	...	...	...	33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Ascaris lumbricoides ...	...	...	...	...	...	...	...	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Schistosoma hæmatobium	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Schistosoma mansoni ...	...	...	...	...	...	...	...	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Tænia saginata	...	...	...	...	...	...	...	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Trichiuris trichiura ...	...	...	...	...	...	...	...	26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova double infections... ...	...	...	...	...	...	...	...	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova triple infections	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova quadruple infections ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Larvæ Strongyloides stercoralis	...	...	...	...	...	...	...	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negative	832	13	...	5	86	47	83	190	...	1	4	5	19	1	488	14	215	...	...	2	104	2	...	2	2	3825	4	3	4	...	...	...
Agglutination Tests.																																
Bacillus typhosus	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus paratyphosus A. ...	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus paratyphosus B. ...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus paratyphosus C. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus proteus X19	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Micrococcus melitensis ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negative	185	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cultural Examinations.																																
Bacillus coli	...	...	...	...	...	...	...	28	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus pestis	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
Bacillus resembling B. pestis...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus typhosus	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pneumococcus	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Staphylococcus	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Streptococcus	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Monilia	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negative	20	...	...	...	...	...	...	22	...	...	...	...	4	1	...	...	4	4	...	...	...	...	...	...	...	...	...	...	...	...	...	2
General Chemical and Microscopical Examination	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	118	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Complete Bacteriological Examination	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	3	...
Wassermann Reactions :—																																
Positive result	196	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negative result	121	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Histological Examination ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	...	...	...	...	...	...	...	...	...	...	...	...	...

Total Examinations made ... ... 7,502.

Stock Vaccines Issued.

Desiccated calf lymph ...	17,300	doses.
Glycerinated calf lymph ...	65,971	,,
T.A.B. vaccine	800	,,

Autogenous Vaccines Prepared	54
Of Bacillus coli	27
Of Staphylococcus	19
Of Streptococcus	1
Of Micrococcus catarrhalis and Staphylococcus	1
For acne	2
For asthma	1
For pyorrhoea	3

APPENDIX II.

VACCINATION, 1921.

Compiled from figures supplied by the Chief Sanitation Officer and from Laboratory Returns.

Stations.	Doses issued.	Vaccinations.			
		Total.	Successful.	Unsuccessful.	Results Unknown.
Eldama Ravine	950	563	7	—	556
Eldoret	30	23	18	—	5
Embu	725	1,415	93	48	1,274
Fort-Hall	1,400	1,323	—	—	1,323
Kabarnet	600	204	186	12	6
Kacheliba	100	?	?	?	?
Kakamega	5,200	1,542	28	2	1,512
Kericho	12,900	11,666	126	107	11,433
Kikuyu Mission	151	?	?	?	?
Kisii	500	690	68	13	609
Kismayu	200	486	81	87	318
Kisumu	25,600	24,707	22	—	24,685
Kitui	150	90	50	12	28
Kyambu	320	175	31	8	136
Lamu	10,600	7,557	3,863	2,106	1,588
Machakos	1,600	15	—	—	15
Magadi	95	17	15	—	2
Malindi	200	17	—	—	17
Meru	200	268	194	48	26
Mombasa	13,270	4,530	1,784	154	1,592
Mombasa Prison	—	950	508	349	93
Nairobi (M.O.H.)	1,163	1,122	103	230	789
Nairobi (Police)	1,000	235	94	59	82
Nairobi (Prison)	—	640	124	150	366
Naivasha	185	75	20	43	12
Nakuru	198	121	—	—	121
Nandi	160	21	—	—	21
Narok	200	124	63	54	7
Nyeri	100	—	—	—	—
Rumuruti	200	?	?	?	?
Samburi	800	302	81	198	23
Turkhana	800	?	?	?	?
Voi	45	31	6	20	5
Wazir	800	?	?	?	?
Total	80,442	58,909	7,565	3,700	47,644

APPENDIX III.

FURTHER NOTES ON A TYPHUS-LIKE DISEASE OCCURRING IN THE HIGHLANDS OF KENYA COLONY.

A description of four cases of suspected typhus will be found in the appendix to the Annual Medical Report for this Colony for 1920 written by Dr. Gilks, the Principal Medical Officer. The present notes bring the knowledge of the disease in Kenya up-to-date, although it must be acknowledged that beyond adding to the list of cases, very little has been done to elucidate the epidemiology, or determine the true nature of the infection. All the cases described in the first and in this paper occurred in the Highlands of Kenya. No cases have been reported from the Tropical Coast zone or from the hot Lake area.

Cases 1 to 9 were treated in Nairobi, and cases 10 to 12 in Nakuru. The four cases described in the first paper are referred to when necessary in this note under the numbers then given to them. The clinical notes of cases 5 to 9 were supplied by Dr. Welch, Resident Surgical Officer, Nairobi, and of cases 10 to 12 by Dr. Wilson, Senior Medical Officer, Nakuru.

CASE No. 5.

European Male Adult. Chart No. 7.

History.—Taken ill on the 4th April, 1921, with intense headache and pyrexia.

On examination 9.4.21.—There is a general discrete papular rash on the face, abdomen, arms, legs, palms of the hands and soles of the feet.

Tongue.—Very foul.

Chest.—Nil.

Abdomen.—Spleen enlarged.

Urine.—Phosphates.

Lymphatic glands enlarged on both sides of the neck.

On the back of the neck is a clean cut ulcer which the patient ascribes to the bite of an insect while riding in a rickshaw ten days before the onset of the headache.

11.4.21. Rash much more marked.

16.4.21. Temperature normal.

The rash persisted seven days after the fall of the temperature to normal.

Patient's serum agglutinated B. proteus X.19 on the 12th day of illness in a dilution of 1 in 128.

CASE No. 6.

Female European Adult. (Chart No. 8.)

History.—12.5.21.—Complains of having suffered from pyrexia, headache and pain localised in the right mastoid region.

On examination 16.5.21.—A faint generalized papular rash.

Enlarged glands on both sides of the neck.

Tongue.—Dry and dirty.

Spleen.—Palpable.

Agglutination.—Negative to B. proteus X.19.

17.5.21. Rash very pronounced and generalized. There are several spots on the palms of the hands and soles of the feet. Headache, backache and joint pains very severe.

27.5.21. Temperature normal. Agglutination to B. proteus X.19 is present in a dilution of 1 in 60 of the patient's serum.

The rash persisted eight days after the temperature fell to normal.

CASE No. 7.

European Male. Age 35. (Chart No. 9.)

History.—Onset sudden on the 13th July, 1921, with headache and rigor. The headache was intense and accompanied by photophobia.

A rash appeared on the 18th July commencing on the arms and abdomen.

On examination 23.7.21 complains of a severe headache.

Temperature.—104° F. Pulse 100.

Abdomen.—Spleen palpable.

Chest.—Nil.

Urine.—Nil.

Tongue.—Foul and dirty.

Rash.—A papular rash all over the body most marked on the arms and legs, involving the palms of the hands and the soles of the feet.

29.7.21. Temperature normal. Agglutination to B. proteus X.19 is present in a dilution of 1 in 160 of the patient's serum.

The rash persisted until the 2nd August.

The patient made an uninterrupted recovery.

CASE No. 8.

European Female. Age 47. (Chart No. 10.)

History.—13.8.21. Complains of having been taken ill eight days previously with headache, and pains in the back and joints.

Two days ago a rash appeared.

On examination there was a generalized papular rash involving the palms of the hands and the soles of the feet.

Tongue.—Very foul and dirty.

Chest.—Nil.

Abdomen.—Spleen enlarged one finger's breadth below the costal margin.

Urine.—Trace of albumin.

17.8.21. Agglutination present with the patient's serum in a dilution of 1 in 180 with B. proteus X.19.

18.8.21. Defervescence.

22.8.21. Rash faded.

The patient made an uninterrupted recovery.

The following case occurred in a private house.

There is unfortunately no temperature chart available.

CASE No. 9.

European Female. Adult.

History.—Illness commenced with a sore throat and acute pains all over the body, somewhat resembling influenza. Temperature was 101° F. and varied between 100° and 101° for four days.

Fifth day.—Temperature 102°. There was a discrete papular red rash on the extensor surface of both forearms. Slight rash on the face. The conjunctivæ showed marked injection. Headache very marked.

Sixth day.—Rash generalized, involving the palms of the hands and soles of the feet. There were no enlarged glands and no history of a bite.

Spleen.—Negative.

Urine.—Negative.

Temperature fell to normal on the 11th day. The rash was still visible three days later.

Tenth day.—Blood negative to Weil Felix reaction.

Three weeks later the patient was still very weak and debilitated.

The following three cases occurred at Nakuru:—

CASE No. 10.

Male. Age 28. (No chart available.)

History.—Taken ill about 2.8.20.

First seen 6.8.20. Very ill. Temperature 103° F. Sleepless.

Furred tongue. Pains in joints marked.

Rash just appearing, well marked on arms and leg and of a purplish colour—some spots petechial. A supurating yellow ulcer on leg, to which he ascribed illness, suggesting it was a tick bite. A patch of broncho-pneumonia present in lung and profuse expectoration.

10.8.20. Patient having continued very ill with temperature 103° F. was now in a "typhoid" state.

Rash fading.

14.8.20. Patient already getting better.

CASE No. 11.

European Male Adult. (Chart No. 11.)

History.—Admitted 8.1.21 as a doubtful enteric. Stated had been badly bitten by unknown insect in Nairobi about 10 days previously. No bites seen.

9.1.21. "Sore" all over. Sleepless. Headache. Rash commencing.

10.1.21. Headache. Sore throat. Cough. "Rash more profuse."

11.1.21. Headache very severe. Sleepless.

12.1.21. Rash on hands.

13.1.21. Drowsy—later restless. Rash fading on abdomen.

14.1.21. Severe headache. Throat painful.

15.1.21. Headache still severe, and throat very painful. Rash disappearing on body but still on arms, legs and buttocks.

16.1.21. Better.

17.1.21. Better but still headache.

18.1.21. Much better. Blood examination for enteric (result negative).

CASE No. 12.

European Male. Aged 26. (Chart No. 12.)

History.—First felt ill 8.2.21. Carried on work till 11.2.21.

First seen 12.2.21. Rash all over body and extremities, including palms of the hands and soles of the feet. Confused in mind. Temperature about 103° F. Severe headache. "Typhus" diagnosed at sight. Admitted to hospital on the same day.

13.2.21. Very restless and delirious. Later drowsy, severe headache. Pain all over body.

14.2.21. Rash still coming out. Headache and sore throat present. Alternately delirious and drowsy, but not sleeping.

15.2.21. Rash still coming out. Feeling better and beginning to sleep.

16.2.21. Again very delirious. Restless.

17.2.21. Rash still coming out on back and abdomen. Incontinence of urine and fæces with muttering delirium. Joints very painful.

18.2.21. Quieter. Rash still marked. Vertigo and headache present. Later stupor—pain in legs—rash fainter.

19.2.21. Rash fading. Tongue beginning to clear. Still delirious.

20.2.21. Patient rational and comfortable.

LABORATORY WORK.

As stated above, the B. proteus X.19 was received in time to do an agglutination test on case No. 3. Thereafter the Weil Felix reaction was carried out on all cases of the disease.

The reactions were carried out by the method described by Garrow in the *Journal of the Royal Army Medical Corps,* Vol. 28, 1917. Emulsions were obtained by growing the organism on glucose agar in a Roux flask and washing off the resulting growth in 24 hours with a 0·5 per cent. solution of formalin in normal saline. The resulting emulsion was centrifuged in a high speed centrifuge and the supernatant fluid pipetted off. This was repeated several times until a uniform white emulsion was obtained. The emulsion was standardized by the opacity method described by Broughton Alcock in the *Journal of the Royal Army Medical Corps,* 1918, Vol. 30. All agglutinations were controlled by a saline control and by a high titre positive serum.

The agglutination results are given in the case histories. One case gave no agglutination at all, and two of the cases gave a low titre, case No. 3, for example, only gave a titre of 1 in 40. This case, however, was the first one in which the agglutination was performed, and in making the emulsion for it, the B. proteus was grown in ordinary agar, and not glucose agar, and this may have affected the titre of the agglutination. Still, it will be seen that the titre rose from negative on the fifth day to 1 in 40 on the tenth day.

These titres may appear too low to be taken as positive confirmation of the diagnosis of typhus fever, but it is difficult to discover what titre should be accepted. Some observers say that a dilution of less than 1 in 200 should not be taken, others demand one of 1 in 100, and others again one of 1 in 50.

Dr. Pirie, Superintendent, Routine Division, South African Institute for Medical Research, informs me that:—

> "Our experience of the reaction as diagnostic has been disappointing. No case so far, even when tested about the twelfth day or during early convalescence, and from cases which clinically were severe Typhus, has given a reaction in dilutions of greater than 1 in 500, many have only reacted in dilutions of about 1 in 10 to 1 in 40, and others have given no reaction at all."

It is probable that this low titre is on a parallel with our experience in agglutination reactions in cases of the Enterica and Dysentery. In the Enterica as has been noted formerly in the Nairobi Laboratory Annual Reports, it is not uncommon to fail to get agglutination at all or to get in only in late convalescence. (A note on such a case is given in the Nairobi Laboratory Annual Report, 1919.) Also the agglutination given with Flexner's bacillus is uniformly low in Kenya compared with elsewhere.

In order to determine if agglutinins for B. proteus X.19 are present normally in the blood of local residents, the Weil Felix reaction was performed on sera obtained from 93 patients in the Native Civil Hospital, Nairobi, selected at random from the medical and surgical wards. Out of these, four gave an agglutination of 1 in 10 to B. proteus X.19, and one a titre of 1 in 10 to B. typhosus and B. paratyphosus A., B. and C., and of 1 in 40 to B. proteus X.19. It has therefore tentatively been decided to accept a titre of 1 in 50 as useful corroborative evidence. Case No. 9 gave no agglutinuation whatever, not even with a serum dilution of 1 in 10 on the tenth day of illness. This was unfortunate, as from that case three guinea pigs were inoculated for immunity experiments. But still according to most observers, a small proportion of cases may not agglutinate B. proteus X.19 even in known Typhus. The guinea pigs were inoculated intraperitoneally each with 3 c.c. of freshly drawn venous blood. From the temperature charts attached (charts 13-16), it will be seen that all these pigs ran a very similar temperature curve, markedly different from that of the control animal. No attempt has been made to carry on the virus as we have not a large enough supply of guinea pigs for the work, but it is hoped to bring the four animals to England for further immunity investigations.

The clinical appearance of the disease is that of a mild Typhus, such as described by Brill, and the agglutination results support this idea. It is difficult, however, to trace out the source of the infection. Typhus is a louse-borne disease. Nuttall, in an article "Lice and Disease" (Parasitology, Vol. 10, p. 56), states that lice are the only known vectors of Typhus. Yet all the cases in which the disease has been observed in Kenya have been Europeans of the well-to-do class. None of the patients had vermin, and all were of cleanly habits and so unlikely to harbour them. Granted that a European may pick up a stray louse in a rickshaw, railway carriage, or in his office, the chances of that louse being an infected one are very small, for a patient suffering from Typhus only carries the virus in his blood during the pyrexial period, and the life of a louse is at most 30 days. In the literature available I cannot find that any conclusion has been reached as to the length of time a louse can carry the infection, but if it is assumed that it may carry the infection during the remainder of its life, the duration of infectivity is not likely to be on the average much more than 14 days.

It is not impossible that Europeans may pick up an occasional infected louse, but it must be a very rare event, unless there is a large reservoir of infection. The unlikelihood of its happening would account for the particularly scattered distribution of the cases. Up to the present we have never seen more than one case in the same house or family, nor is the incidence confined to any one quarter of the European area.

Even granting the possibility of an European picking up an infected louse, the source of the infection of the louse is still obscure. It may be postulated that typhus is an endemic disease among the local natives, and the latter have acquired such resistance that they only suffer from the disease in a mild form unrecognizable as typhus. An ambulant variety such as this could transmit the virus to a non-resistant individual, who would then probably develop the disease in a more typical form.

That typhus does exist in an attenuated form has frequently been recorded. Hall (Typhus Fever—Military Surgeon, 1916, Vol. 39, No. 5) states that in children the rash in the milder cases is generally transitory, while a prominent symptom may mask the true nature of the case. Brohn (Munch. Med. Woch., 1918, Sept. 3rd) states that typhus in children may be unaccompanied by a rash. Martini (Deut. Med. Woch., Feb. 7th, 1918) points out the great danger to the adult community of mild cases occurring in children and of the possibility of the transmissions of the disease by unrecognised cases. Potel (Arch. Med. et Pham. Nav., June and July, 1917) states that among the Serbians the disease usually showed marked benignity—without exanthem or rash—and its existence was unsuspected until cases began to appear among French hospital orderlies.

Instances are also on record of outbreaks of typhus where no communication with any previous case or source of infection could be traced. Stack, in the *British Medical Journal*, 9th February, 1918, records one such outbreak, and Kantor (*Journal of Infectious Diseases*, Vol. 17, 1918) describes three cases of typhus among immigrants which must have been contracted on board ship, although no know case occurred during the voyage.

But there is still a serious flaw in this supposition. The European is not the only non-resistant individual in the Highlands of Kenya. It is a well known fact that typhus is a disease of temperate climates and is not endemic in tropical regions. Now in Nairobi there is a very mixed population drawn from all parts of the Protectorate. There are Kavirondo and Baganda from the hot Lake area, Swahili from the tropical Coast zone, Somali from the Desert zone and Indians from the hot and steamy parts of India. These in number would almost equal the total number of local natives, and are presumably non-resistant to typhus, yet in spite of careful observation, not a single case of typhus or a disease resembling it, has been seen amongst them. This is the most weighty argument against the cases herein described being typhus. All the other non-resistant peoples who come into much more intimate contact with the local native than the European, would appear to escape infection, a very extraordinary fact if the disease is typhus carried from an immune local tribe.

Another possibility is that the disease is one resembling Spotted Fever of the Rocky Mountains, in that it has an animal host and not a human one, the vector being a tick. It is interesting to note that a similar theory has been suggested by Lt.-Col. Megaw in the *Indian Medical Gazette*, October, 1921, in an article on a Typhus-like Fever in some small hill stations at an altitude of 4,500 feet.

No work has been done here on the latter theory yet, nor is it proposed to do any until the present investigation is completed. When that is done, it should be possible to state with a fair degree of certainty whether these cases were typhus or not. It is to be regretted that our laboraory work cannot be completed in time to appear in these notes, and that in consequence it is not possible to draw any definite conclusions from our present knowledge. This must be left for a future report.

APPENDIX IV.

A PRELIMINARY NOTE ON THE USE OF AN AUTOGENOUS COLI-TYPHOID VACCINE IN THE TREATMENT OF DISEASES DUE TO INTESTINAL TOXÆMIA AND PARTICULARLY RHEUMATOID ARTHRITIS.

Experience with the vaccine reported on in this paper dated from August, 1919, but owing to fourteen months' absence from the Colony on leave, and the large amount of administrative and routine work which has to be carried on by an inadequate staff in addition to research work, nothing more than a summary of results obtained in this country and details of the preparation of the vaccine can be given in this preliminary note. The publication of these details has been thought advisable in view of the encouraging results obtained here and in the hope that other workers will give the method a trial. Full details of the cases with a description of the baccilli concerned will be given in a later paper.

The original patient was case 237, an account of whose lesions is given below. He was sent to the Laboratory by Dr. Gilks, Principal Medical Officer of the Colony, but at that time Resident Surgical Officer at the European Hospital, Nairobi, with a view to determining whether any vaccine treatment was possible or advisable. The usual sites of septic absorption was examined and eliminated one by one until they were narrowed down to the bowel. It was then that the idea of isolating a number of organisms from the fæces and testing their agglutinability by the patient's serum suggested itself to me. A number of lactose fermenters were isolated on MacConkey's lactose bile-salt neutral red agar and sub-cultured on to agar slopes. The purity of these cultures was then tested, and when this was assured, their agglutination reactions with the patient's serum were tested. One organism agglutinated markedly and from it the vaccine was prepared. The initial dose was made very small, namely under one million bacilli to the dose. Succeeding doses were put up so that each was twice as strong as its immediate predecessor. The vaccine was administered at weekly intervals. No reaction was observed with the first few doses, but as the strength of the injection gradually increased, more and more reaction was seen and distinct improvement in the direction of lessened pain, increased freedom of movement and cessation of the progressive character of the disease, followed. The results eventually obtained were so striking that application for similar vaccines began to come in from medical practitioners and from the lay public. The demands became so great at one time that the depleted staff of the Laboratory was unable to cope with them. This in itself is not without weight as a testimony to the effect of the vaccine, although of no value as scientific proof. The original case 237 has now been under observation for a period of 2½ years, and the improvement has persisted up to the present.

The method used in the preparation of the vaccine has been modified as more and more cases have come up for treatment. We do not pretend that the best method has even yet been attained, and it is possible that as good results may be obtained with a simplified technique. The one used at present is as follows:—

A small platinum-loopful of a recently passed stool of the patient is inoculated into each of two tubes containing bile-salt peptone water (sodium taurocholate 0·5 per cent., peptone, 1 per cent.). The tubes are incubated at 37° C. for 24 hours, and then a loopful from each is spread over the surface of MacConkey's neutral red bile-salt lactose peptone agar in Petri dishes which must be in sufficient number to ensure isolated colonies on the last plates seeded (four plates to each loopful usually suffice). These plates are incubated at 37° C. for 24 hours, and then colonies are picked off into tubes of nutrient broth, and after incubation the various cultures are tested for agglutination against the patient's serum. Three methods have been employed in testing this. The original one was that described by Broughton-Alcock.(¹) This did not prove very satisfactory in practice, possibly owing to the delay experienced in the reaction with bacilli of the coli group. The microscopic method was then adopted. A serum dilution of 1 in 30 is used with the culture under examination and a control with saline is put up at the same time. Agglutination is usually found to take place within half an hour, in cases which prove to be positive, and any agglutination after an hour has elapsed is reckoned as negative. This method has proved most useful in practice in this Laboratory, as the senior Indian assistant has had many years of practice in it in testing for typhoid agglutination, and with our small staff it has been found necessary to delegate as much as possible of the less skilled portion of the method to the subordinate staff. All reactions are checked and read by one of the medical officers. The third method of testing agglutination is that of

Dreyer, modified firstly by the use of Donald's drop pipettes, secondly by using a serum dilution of 1 in 50, and thirdly by incubating the tubes containing the serum dilutions and cultures in a water bath at 50° C. for four hours. Unless these modifications are used the results do not agree with those obtained by the microscopic method. This has been also pointed out by Dudgeon, Wordley and Bawtree.(²) Those cultures which show agglutination are again plated out on MacConkey agar in Petri dishes and incubated for 24 hours at 37° C. At the end of this time isolated colonies are picked out and inoculated into nutrient broth, and after a further incubation these cultures are again tested as to their agglutinability with the patient's serum. If there is any doubt as to the purity of the cultures which show agglutination now, the process of plating out on MacConkey agar is repeated. The cultures which are finally passed as pure, and as agglutinating with the patient's serum, are subcultured on to agar slopes. The resulting growths are washed off with 0·5 per cent. solution of carbolic acid in normal saline (freshly made up at the time of use), and the emulsion so obtained shaken in a vaccine shaker in a sterile bottle containing glass beads for an hour or more until the bacteria are uniformly distributed throughout the liquid. The emulsion is then allowed to stand for 48 hours, when a loopful is subcultured on to an agar slope. As soon as the vaccine is sterile by this test, it is standarised by the method described by Brown(³) to contain 0·01 mgm. of the dried bacilli in the first dose. Succeeding doses are now made to increase in strength according to the condition of the disease in the patient. As a rule the early doses can be made so that each is twice as strong as the preceding one. The later doses should increase in strength less rapidly. The vaccine is administered at intervals which vary with the reaction experienced by the patient, a period of three clear days after all reaction from the previous dose being usually sufficient.

It is impossible to discuss adequately in the present paper the pathological conditions in which the vaccine has proved of value. It would seem that there is a certain group of diseases attributable to the absorption of toxins or even of bacilli from the gut. Chief amongst those which have come under our notice for vaccine treatment are diseased conditions of joints which are grouped under the somewhat comprehensive term of rheumatoid arthritis. Clinically many of the joint cases treated by us conform to one or other of the types of rheumatoid arthritis as described in the text-books. Some were diagnosed by specialists in England as such. It is suggestive that every one of these cases showed bacilli of the coli-typhoid group which agglutinated with the patient's serum. Of course it is open for anyone to object that normal people may agglutinate such bacilli, but so far no normal person examined by us has shown such organism, and two cases of gonorrhœal arthritis gave no serum reaction with any of the bacilli isolated by us. Dudgeon, Wordley & Bawtree(⁴) in their paper state that out of 66 normal individuals examined for agglutinins for B. coli, only five showed any. One cannot however, attribute all cases of rheumatoid arthritis to absorption of toxins or bacilli from the gut as several cases showing this condition clinically, gave no agglutination with any bacilli isolated from the fæces. On our results it may be claimed, however, that in such cases should one be able to isolate from the fæces bacilli which agglutinate with the patient's serum, a vaccine prepared from these bacilli will usually bring about considerable improvement or even cure, if the disorganisation of the joints has not proceeded to such a degree as to prohibit the complete return to normal.

In addition to these arthritis cases which so far have formed the bulk of our patients, a few persons have been treated provisionally with an autogenous vaccine prepared as described above for diseased conditions which have to our mind showed some probability of intestinal autointoxication as the basic lesion. Most of these have asked for relief for indeterminate aches and pains or even for mere malaise. Close questioning has usually revealed some development of one or more joints in a very early stage of the disease. One case treated showed no joint lesions at all but complained of chronic indigestion. Investigation revealed symptoms which might be attributed to intestinal toxæmia and an autogenous vaccine has given much relief after only two or three doses, but it is too early to count this as a cure. One case suffered from periodic sciatica with great disability even between attacks. She had suffered from dysentery some little time before the commencement of the disease, and there was a definite colitis present. A vaccine was prepared and considerable relief followed the first two doses. The patient then left for Europe taking the vaccine with her, and up to the present no further reports have been received.

The work of identifying the bacilli isolated in the various cases treated up to the present is still in progress. A number have been put through the sugars, but at the time of writing it is impossible to say more than that the majority of the bacilli are lactose fermenters and that, though many of them have very similar action on the various sugars, yet they are not identical, and even in the same case two or more organisms differing in fermentative capacity may be isolated. It may be that as the serum relationships are further investigated we shall find that all the bacilli belong to one or two serum types only. This point is being determined at the present moment as well as the equally important question of the pathological action of these same bacilli on joints.

One point that may be noticed is that in one case at present under treatment, and so not recorded here, the patient suffered from periodic febrile attacks every few days and during these attacks passed bacilli in the urine identical with those isolated from the stool and agglutinated by the patient's serum.

Appended are short clinical notes on the various cases treated up to date as far as these are available, dates in brackets being those of vaccine treatment.

CASE 237.—Male (August, 1919).—Rheumatism began in 1913 in the shoulders, wrists and ankles. Was treated with salicylates, potassium iodide, liniment and radiant heat. Slight local improvement resulted but the general condition remained unchanged. Developed endocarditis at the end of 1913. In bed for 3 months and off duty for 6 months. Was advised to come to East Africa in 1917, when he had considerable pain but little fixation of the joints. The pain became worse and the joints, especially the left shoulder and right wrist, became more or less fixed. In 1918 he first came under observation by Dr. Gilks. The left shoulder joint showed much limitation of movement, and marked creaking was observable on attempting to move it. The shoulder muscles were very wasted. The right wrist was swollen, the swelling involving the carpal joints as well, while there was considerable bony deformity and a great thickening of the periarticular fibrous tissue. Movement was practically absent. The phalangeal joints of the fingers showed spindle-shaped swelling with much restriction of movement, though bony deformity was absent. Other joints were affected less markedly though in most there was considerable pain. Vaccine treatment was commenced in August, 1919. Twenty doses were given at weekly intervals, the first ten ranging in strength from 1 to 512 million bacilli and the second ten from 128 to 1,024 million. The patient is at present having a third series of injections in doses ranging from 14 to 2,000 million bacilli as an insurance against a recurrence. His general health has greatly improved. He is fatter, has a good appetite, is not depressed mentally, and the muscles have recovered a good deal of their tone. The movement of the left shoulder has increased so that he can touch his right ear over the top of his head. The movement of the right wrist has not improved. The finger joints are now normal in shape and movement. There is no pain in any of the joints of the body. The patient can now play tennis and ride a motor cycle, both of which amusements were formerly impossible.

CASE 321.—Female. (April, 1920).—Complained of pain and disability in the left knee. Rheumatic pain in it for years. Knee somewhat swollen, synovial membrane thickened, and much creaking and pain on movement, which was limited. Had ten doses of vaccine. Pain disappeared, the joint became normal in size, the thickening of the synovial membrane became much less and the limitation of movement ceased. No recurrence up to the present time, and this patient recently won a golf championship.

CASE 345. Female. (May, 1920). Age 53.—History of rheumatic fever 12 years ago. Twinges of rheumatism all life. In June, 1915, developed pain, stiffness and swelling in the right knee and had to walk with a stick. Had marked pyorrhœa. Returned to England and was treated at Buxton. All her teeth were removed and the rheumatism improved. On the return voyage, the weather was very bad and the left knee became affected. Then the disease spread to the right hand, both ankles, and then to other joints. She gradually became more crippled. In June, 1920, could only shuffle about with a stick. Back was bowed, and stoop on walking stick was marked. Knees very swollen owing chiefly to bony and synovial thickening. Fluid in them was not great. The right ankle was swollen from the same causes. Both hands were swollen. The right hand was crippled, the fingers being flexed and ankylosed, with marked ulnar flexion. The left hand showed slight ulnar flexion. Ordinary rheumatic treatment with salicylates, iodide and radiant heat had no effect. Vaccine administration began in July, 1920. Improvement has continued steadily ever since. There is no pain, and patient can walk two miles with ease, and does not now use a stick. She takes full school duties. Her back is straight and there is no stoop when walking. There is some slight swelling in the knees, and the movement is only three-quarters of normal, though there is full extension. The swelling is due to bony enlargement. The right hand is still deformed, but the use of it has been largely regained. Only bony deformity remains, and the ulnar flexion has become less marked. The left hand still shows bony enlargement of the metacarpo-phalangeal joints of the index and middle fingers. The patient's general health is greatly improved, although she still lives under the same conditions and in the same bungalow as when the disease began.

CASE No. 356. Male. (June, 1920). Three years' history.—Complained of pain in the hip joint which caused his legs at times to give way suddenly under him. Pain in other joints on the approach of rainy weather. No limitation of movement observable. Diagnosed as rheumatoid arthritis by specialist in England after X-ray examination. Some swelling observable in the ankle joints, but no limitation of movement. First course of vaccine had done no appreciable good at the conclusion of the injections, but the patient returned shortly afterwards to report that he was distinctly better. At his own request he had a second course then, and has recently had a third. He states that when on leave in England after the second course his doctor said that he had never expected to see him again. At the present moment the pain has entirely left the hip joints and his legs never give way now. His ankles have become normal though he gets slight pain in them when rain is approaching.

Case 373. Male. (July, 1920).—Six years' history of recurrent attacks of rheumatism particularly affecting the legs and knees. Was admitted to a nursing home. Then had slight pyrexia at night, severe pain in both legs, and swelling of the knees, both of which contained fluid. Had eight doses of vaccine. Completely free from symptoms for 18 months although has been elephant shooting. Had a slight recurrence of pain after sleeping out in the rain one night during a hunting trip, and came in at once for more vaccine. Further treatment has cured the relapse.

Case S. Female. (November, 1920).—Had three years' history of increasing pain in small joints of the hands and feet. The hands were almost crippled, and could not be closed. The phalangeal joints of both hands showed spindle-shaped swelling with thickening of the peri-articular fibrous tissue and marked limitation of movement. There was ulnar flexion of the hands. Had ten doses of vaccine. There was entire absence of pain for fifteen months, but there has been slight recurrence of this symptom during the last month and the patient is having a second course of vaccine for this. Although the deformity of the joints has not quite disappeared, it is much less and the limitation of movement has gone, so that the patient is able to carry out her ordinary occupation of farming.

Case W. Male. (November, 1920).—Has had pain and swelling in both knees for three or four months following a soaking in the rain. The knee showed a considerable amount of fluid, but no other pathological changes. Eight doses of vaccine caused a complete cure.

Case 453. Male. (November, 1920).—Acute onset with marked pyrexia. All the joints of the body were affected with acute pain. There was great pain on passive movement of the affected joints, with marked tenderness and some swelling. Had ten doses of vaccine. The pain was very much lessened, but the joint changes were not much improved. Went to South Africa, so had no further vaccine treatment. Was still badly crippled in December, 1921.

Case 460. Male. (November, 1920).—Three years' history. Articular rheumatism on change of weather but no bony changes in the joint. Had eight doses of vaccine and has been entirely free from symptoms ever since.

Case 471. Male. (December, 1920).—Symptoms complained of were pain in the right hip joint so that walking more than a mile caused the leg to give way under him. Diagnosed as osteo-arthritis at home from X-ray examination. Large element of neurasthenia present. No definite improvement after the vaccine.

Case 490. Female. (January, 1921).—No history and no notes available. Patient came to the Laboratory just before returning to England for a supply of vaccine to take with her for fear the symptoms might return while away. She reported that the first series of injections had completely cured her.

Case 553. Male. (July, 1921).—History of occipital headache, pain in the cervical spine, and slight evening temperature for four months. Also had muscular rheumatism. Some slight stiffness of the neck and limitation of movement, otherwise no other clinical signs discoverable in the regions affected. Had eight doses of vaccine. Marked improvement followed and a further series of injections resulted in complete cure.

Case 569. Female. (August, 1921).—Eight years' history of rheumatism affecting all the joints of the body. When attack occurred patient became a complete cripple and was unable to move the joints affected. Markedly worse when the rainy weather began. Small joints of the hands affected for three months. Clinically during the attack there was swelling of the affected joint and fixation by contraction of the muscles moving the joint. Some of the phalangeal joints of the fingers were spindle-shaped with some thickening of the peri-articular tissues. Had eight doses of vaccine. Has since been completely free from symptoms until the rains began a few weeks ago, when there was a slight recurrence of pain in one arm. Further injections of vaccine resulted in cure.

Case 577. Male. (August, 1921).—Had four years' history of rheumatism, the attacks lasting three or four months at a time. Was admitted to hospital 29.8.21, having been ill for five weeks with intense pain in the left hip and along the left sciatic nerve with much wasting of the leg. There was a pyrexia to 100° F. at night. Had six doses of vaccine. Since his discharge from hospital has been on safari and has had no recurrence of the pain.

Case 580. Male. (September, 1921).—Symptoms identical with those of case 553. Had ten doses of vaccine. Has been completely free from symptoms ever since.

Case 586. Male. (October, 1921).—Age 75.—30 years' history of rheumatism. Been all over the world in search of a cure with no result. Arthritis of both knee-joints, and the small joints of the hands and feet. Marked bony changes in the joints, causing great deformity of the hands with ulnar flexion, and almost complete inability to grasp anything with them. The same change, though less marked, had taken place in the knees and feet, so that the patient was very lame and practically unable to walk. Had 12 doses of the vaccine. No improvement took place beyond a slight diminution of the rheumatic fibrous nodules over the metacarpo-phalangeal joints of the hands, and some lessening of the pain.

Case 615. Male. (November, 1921).—History of rheumatism. Three weeks before treatment had acute pain in one ankle which incapacitated him for games. Tenderness but no clinical changes in joint. Salicylates gave no relief. Ten doses of vaccine brought about complete cure. Patient now enjoys active life and plays football regularly.

Case 644. Female. (December, 1921).—Long history of rheumatism in the hands and legs. Recently suffered from occipital headache with marked tenderness along the cervical spine. There was also pain and peri-articular fibrous thickening round the articulations of the fingers. Ten doses of vaccine effected a complete cure.

Eleven other cases are at present under treatment, but it is too early to judge of results. Cases 315, 324, 362, 394, 397, 428, 475, 494, 503, 535 and 610 I have been unable to trace and can obtain no notes on their original condition or of the effects of the vaccine.

Of the cases completed and recorded, I think it may be claimed that Nos. 373, W., 460, 490, 553, 569, 577, 580, 615 and 644 are complete cures, and that Nos. 237, 321, 345, 356, and S., although the condition has not returned to normal, are as much improved as the permanent deformity due to the disease will allow. Case 453 can only be considered as very slightly improved, while cases 471 and 586 must be reckoned complete failures, understandable perhaps in case 586.

From these results it would seem that this method of treatment is worthy of trial in a more extended series of cases than we have at our disposal here. One factor that would have to be taken into account in other countries is that the development of agglutinins as a response to bacillary infection is much less in this part of the world than in England, as has been frequently remarked in reports of Widal reactions here, and also in the experimental inoculation of animals. It may be, therefore, that agglutination with a greater dilution of serum than 1 in 30 for the microscopical method, and 1 in 50 for Dreyer's method will be required as a standard elsewhere to eliminate natural agglutinins in the blood.

Dr. Gilks, Principal Medical Officer, supplied the clinical details of cases 237 and 345, and Dr. Welch, Resident Surgical Officer, European Hospital, Nairobi, the notes of cases 373, S., W., 453, 460, 471, 553, 569, 577, 615, and 644.

References.

1. W. Broughton Alcock, *R.A.M.C. Journal*, Vol. 30, p. 424.
2. Dudgeon, Wordley & Bawtree, *Journal of Hygiene*, Vol. 20, p. 158.
3. Brown, *Indian Journal of Medical Research*, July, 1919.
4. Dudgeon, Wordley & Bawtree, *Journal of Hygiene*, Vol. 20, p. 149.

APPENDIX V.

WATER EXAMINATIONS.

Serial No	Source.	Colonies on Gelatine per c.c. 3 days.	Colonies on Agar per c.c. 2 days.	Colonies on L.B.A. per c.c. 2 days.	B. Coli per litre.	Streptococci per litre.	Bacillus enteritidis sporogenes per litre.
45	Soda water	0	?	0	< 20	< 20	< 20
46	Soda water	60	?	0	< 20	< 20	< 22
47	Soda water	50	6	4	< 20	< 20	< 20
48	Soda water	1	?	1	< 20	< 20	< 20
49	Soda water	0	?	0	< 20	< 20	< 20
50	Kabuggai spring ...	∞	?	∞	100–1000	< 20	> 100
51	Soda water	0	0	0	< 20	< 20	< 20
52	Ginger ale	∞	?	∞	100–1000	< 20	< 20
53	Soda water	0	?	20	< 20	< 20	< 20
54	Soda water	0	6	0	100–1000	< 20	< 20
55	Soda water	0	?	0	< 20	< 20	< 20
56	Soda water	0	?	0	< 20	< 20	< 20
57	Soda water	0	?	0	< 20	1000–10000	< 20
58	Nairobi main	?	55	0	100–1000	< 20	> 100
59	Soda water	0	1	0	< 20	< 20	< 20
60	Nairobi main	?	55	0	20–100	< 20	20–100
61	Soda water	—	?	0	< 20	< 20	< 20
62	Soda water	—	16	0	< 20	< 20	< 20
63	Nairobi main	840	312	21	20–100	< 20	> 100
64	Nairobi main	?	?	22	20–100	20–100	20–100
65	Soda water	34	∞	1	< 100	< 20	> 100
66	Soda water	80	16	0	< 20	100–1000	< 20
67	Soda water	0	?	4	< 20	< 20	< 20
68	Soda water	30	?	13	< 100	< 20	< 20
69	Supply Tank, Nairobi ...	2026	463	15	100–1000	20–100	20–100
70	Nairobi main	50	175	21	100–1000	20–100	< 20
71	Nairobi main	24	499	22	< 100	< 20	< 20
72	Soda water	24	?	0	100–1000	< 20	20–100
73	Nairobi main	?	67	9	100–1000	100–1000	> 100
74	Soda water	0	280	0	< 20	< 20	< 20
75	Soda water	—	?	48	< 20	< 20	< 20
76	Zanzibar spring	—	—	∞	< 20	< 20	> 100
77	Zanzibar spring	—	—	∞	< 20	< 20	< 20
78	Zanzibar main	—	—	∞	100–1000	< 20	< 20
79	Zanzibar tank	—	—	∞	1000–10000	< 20	< 20
80	Zanzibar well	—	—	∞	20–100	< 20	20–100
81	Nairobi main	—	—	7	100–1000	< 20	< 20
82	Soda water	318	—	70	< 20	< 20	< 20
83	Soda water	13	—	15	100–1000	< 20	< 20
84	Nairobi main	?	—	11	1000–10000	< 20	< 20
85	Soda water	36	?	80	1000–10000	< 20	< 20
86	Nairobi reservoir ...	83	877	91	1000–10000	< 20	> 100
87	Supply Tank, Nairobi ...	40	527	57	1000–10000	1000–10000	> 100
88	Nairobi main	?	?	166	100–1000	< 20	20–100
89	Parklands main	∞	∞	∞	100–1000	20–100	< 20
90	Soda water	—	7	2	100–1000	< 20	< 20
91	Nairobi Spring No. 1 ...	22	18	5	< 20	< 20	< 20
92	Nairobi Spring No. 2 ...	4	11	0	20–100	< 20	< 20
93	Nairobi Spring No. 3 ...	15	?	0	< 20	< 20	< 20
94	Nairobi Spring No. 4 ...	408	35	0	< 20	< 20	< 20
95	Nairobi Spring No. 5 ...	?	3500	132	< 20	< 20	< 20
96	Nairobi main	31	401	17	100–1000	100–1000	< 20
97	Nairobi Spring No. 6 ...	91	28	0	< 20	20–100	< 20
98	Nairobi Spring No. 7 ...	139	110	3	< 20	20–100	< 20
99	Nairobi new spring ...	10	40	0	20–100	1000–10000	< 20
100	Soda water	0	?	0	< 20	< 20	< 20
101	Nairobi lower reservoir	∞	∞	156	< 20	< 20	< 20
102	Nairobi upper reservoir	71	1144	130	20–100	1000–10000	< 20
103	Supply Tank Nairobi ...	?	?	0	20–100	< 20	< 20
104	Nairobi main	27	48	18	< 20	20–100	< 20
105	Parklands main	?	∞	5	< 20	< 20	< 20
106	Mission spring, Kikuyu	27	49	38	20–100	1000–10000	< 20
107	Catchment drain, Nairobi reservoir	17	121	15	100–1000	> 10000	> 100
108	Soda water	?	103	0	< 20	< 20	< 20
109	Soda water	?	?	42	< 20	< 20	< 20

Appendix V.—*continued.*

Serial No.	Source.	Colonies on Gelatine per c.c. 3 days.	Colonies on Agar per c.c. 2 days.	Colonies on L.B.A. per c.c 2 days.	B. Coli per litre.	Streptococci per litre.	Bacillus enteritidis sporogens per litre.
110	Soda water	?	31	0	< 20	< 20	> 100
111	Soda water	?	?	0	< 20	< 20	< 20
112	Nairobi main	—	112	46	20–100	< 20	< 20
113	Nairobi main	—	278	45	100–1000	< 20	< 20
114	Soda water	—	∞	816	< 100	< 20	< 20
115	Soda water	—	1152	7	< 20	< 20	< 20
116	Nairobi main	18	791	53	< 20	< 20	< 20
117	Soda water	0	18	1	< 20	< 20	< 20
118	Soda water	16	1022	66	< 20	20–100	< 20
119	Nairobi main	27	85	25	1000–10000	< 20	< 20
120	Soda water	2	1772	37	20–100	< 20	< 20
121	Nairobi main	40	243	43	1000–10000	< 20	< 20
122	Nairobi main	12	4112	43	100–1000	20–100	< 20
123	Nairobi main	7	124	24	100–1000	< 20	< 20
124	Nairobi main	20	∞	29	100–1000	< 20	< 20
125	Nairobi main	14	179	54	20–100	100–1000	< 20
126	Soda water	0	145	6	< 20	< 20	< 20
127	Nairobi main	38	265	75	20–100	100–1000	< 20
128	Nairobi main	16	117	242	< 20	20–100	< 20
129	Nairobi main	15	96	54	1000–10000	20–100	< 20
130	Soda water	4	41	5	< 20	< 20	< 20
131	Nairobi Main	?	123	62	1000–10000	20–100	< 20
132	Nairobi Main	162	766	153	1000–10000	20–100	< 20
133	Nairobi Main	—	526	241	> 10000	< 20	20–100
134	Nairobi Main	151	629	140	1000–10000	< 20	< 20
135	Nairobi Main	?	506	209	100–1000	< 20	20–100
136	Kibwezi River	∞	∞	∞	1000–10000	1000–10000	> 100
137	Masongaleni	0	?	12	100–1000	100–1000	> 100
138	Masongaleni	—	—	—	100–1000	100–1000	> 100
139	Masongaleni	—	—	—	1000–10000	100–1000	> 100
140	Nairobi Main	60	380	135	20–100	< 20	20–100
141	Nairobi Main	123	297	72	20–100	< 20	> 100
142	Nairobi Main	45	274	40	20–100	< 20	> 100
143	Nairobi Main	?	640	103	20–100	100–1000	> 100
144	Nairobi Main	?	∞	69	20–100	100–1000	> 100
145	Nairobi Main	83	782	75	20–100	< 20	> 100
146	Nairobi Main	74	348	39	100–1000	20–100	> 100
147	Nairobi Main	101	670	85	1000–10000	20–100	> 100
148	Mombasa Main	∞	∞	∞	20–100	< 20	> 100
149	Mombasa Well	∞	∞	∞	100–1000	< 20	> 100
150	Nairobi Main	?	979	378	1000–10000	< 20	> 100
151	Nairobi Main	?	909	138	1000–10000	< 20	> 100
152	Nairobi Main	36	44	30	100–1000	< 20	> 100

NOTES.

1. Samples 45–126 were examined in 1920 but are included here as a synopsis of them did not accompany the 1920 report.

2. The following samples were taken on the days indicated and are therefore comparable amongst themselves:—

Samples 69, 70	7th June, 1920.
Samples 76, 77, 78, 79, 80	28th June, 1920
Samples 86, 87, 88, 89	9th August, 1920.
Samples 91, 92, 93, 94, 95	23rd August, 1920.
Samples 97, 98, 99	2nd September, 1920.
Samples 101, 102, 103, 104, 105	13th September, 1920.
Samples 106, 107	24th September, 1920.
Samples 136, 137, 138, 139	14th August, 1921.
Samples 148, 149	3rd November, 1921.

3. Samples 76-80 were taken at Zanzibar and packed in a water sample box with ice and dispatched to the Laboratory. As the ice was not renewed and the box took four days to arrive in Nairobi, the greater part of which time was spent in places with a high atmospheric temperature, the examination cannot be considered as of much value in estimating the safety or otherwise of the Zanzibar water supply.

4. In the cases where a high L.B.A. count occurred in association with a low B. coli count, the majority of the colonies on the former medium were non-lactose fermenters.

5. B. coli is only diagnosed when a gram-negative coliform bacillus gives acid and gas in lactose broth, acid and clot in milk, and indol in peptone water.

6. The two waters from Mombasa (samples 148, 149) were four days old when received and the ice in the water sample box was not renewed during the journey. The results of the examination cannot therefore be taken as representing the true condition of the Mombasa water supply.

APPENDIX VI.

DETAILS OF DIFFERENTIAL LEUCOCYTE COUNTS, 1921.

No.	Race.	Age.	Examination for.	Polymorphonuclear Leucocytes.	Large Mononuclear Leucocytes.	Lymphocytes.	Transitional Leucocytes.	Eosinophil Leucocytes.	Myelocytes.	Remarks.
1	N	A	Pyrexia	68	10	13	1	8	—	No parasites
2	E	A	Pyrexia	56	14	20	1	9	—	No parasites
3	E	A	Diff. Count	67	8	18	1	6	—	—
4	E	A	?	78	8	12	—	2	—	—
5	E	A	Pyrexia	3	49	40	8	—	—	No parasites
6	E	A	Pyrexia	47	17	25	6	5	—	No parasites
7	E	A	?	69	9	18	4	—	—	—
8	E	A	Pyrexia	86	8	5	1	—	—	No parasites
9	N	A	Pyrexia	65	5	26	—	4	—	No parasites
10	E	A	Pyrexia	69	19	11	—	1	—	No parasites
11	E	A	?	64	10	20	2	4	—	No parasites
12	E	A	Pyrexia	52	19	28	1	—	—	Polychromes
13	E	A	Pyrexia	83	6	10	1	—	—	No parasites
14	E	A	Pyrexia	63	14	22	—	1	—	No parasites
15	E	A	Pyrexia	20	61	18	1	—	—	No parasites
16	E	A	Pyrexia	72	10	16	1	1	—	No parasites
17	E	C	Pyrexia	56	14	27	3	—	—	No parasites
18	E	A	Diff. Count	30	9	56	4	1	—	No parasites
19	E	A	Pyrexia	59	31	8	2	—	—	No parasites
20	E	A	Pyrexia	42	29	26	3	—	—	Polychromes
21	E	A	Pyrexia	76	18	8	—	—	—	No parasites
22	E	A	Diff. Count	82	10	7	1	—	—	No parasites
23	I	A	Diff. Count	74	10	15	—	1	—	No parasites
24	I	A	Pyrexia	46	12	40	—	2	—	No parasites
25	E	A	Pyrexia	59	13	26	1	1	—	No parasites
26	E	A	Pyrexia	73	8	17	1	1	—	No parasites
27	E	A	Pyrexia	78	8	13	—	1	—	No parasites
28	E	A	Pyrexia	51	12	33	2	2	—	No parasites
29	E	A	Pyrexia	81	3	13	—	3	—	No parasites
30	E	A	?	61	11	25	1	2	—	No parasites
31	E	A	Pyrexia	58	10	27	1	4	—	No parasites
32	E	A	Pyrexia	58	12	22	2	6	—	No parasites
33	E	A	Pyrexia	52	12	31	1	4	—	No parasites
34	E	C	Pyrexia	44	16	36	3	1	—	No parasites
35	N	A	Pyrexia	67	3	23	—	4	3	No parasites
36	E	A	Pyrexia	54	8	32	5	1	—	No parasites
37	E	A	Pyrexia	41	16	39	4	—	—	No parasites
38	E	A	Pyrexia	32	26	36	2	4	—	No parasites
39	E	A	Diff. Count	22	19	56	3	—	—	No parasites
40	E	A	Pyrexia	56	16	20	8	—	—	No parasites
41	E	A	Diff. Count	80	3	17	—	—	—	No parasites
42	?	?	Diff. Count	32	25	11	2	30	—	No parasites
43	E	A	Pyrexia	85	5	6	4	—	—	No parasites
44	E	A	Diff. Count	57	9	27	2	5	—	No parasites
45	I	A	Diff. Count	22	4	73	1	—	—	No parasites
46	E	C	Pyrexia	30	15	14	—	41	—	—
47	E	A	Pyrexia	26	60	9	5	—	—	No parasites
48	E	A	?	65	9	22	4	—	—	No parasites
49	E	A	Pyrexia	93	5	1	—	1	—	Mastoid abscess
50	E	A	Pyrexia	72	14	13	1	—	—	No parasites
51	E	A	Pyrexia	37	43	12	7	1	—	Crescents present
52	N	A	Diff. Count	56	12	24	4	4	—	No parasites
53	E	A	Diff. Count	42	34	18	6	—	—	No parasites
54	?	?	Diff. Count	18	4	56	10	—	12	Poililocytosis
55	I	A	Diff. Count	70	5	25	—	—	—	No parasites
56	E	A	Pyrexia	48	20	12	20	—	—	No parasites

Appendix VI.—*continued.*

No.	Race.	Age.	Examination for.	Polymorphonuclear Leucocytes.	Large Mononuclear Leucocytes.	Lymphocytes.	Transitional Leucocytes.	Eosinophil Leucocytes.	Myelocytes.	Remarks.
57	E	A	Pyrexia	32	8	28	32	—	—	No parasites
58	E	A	Pyrexia	3	16	30	50	—	1	No parasites
59	E	A	Pyrexia	73	12	12	2	1	—	No parasites
60	E	A	Pyrexia	72	7	17	1	3	—	No parasites
61	E	A	Diff. Count	3	30	6	60	—	1	No parasites
62	I	A	Diff. Count	48	5	30	16	1	—	No parasites
63	E	A	Pyrexia	34	8	38	—	20	—	No parasites
64	E	A	Diff. Count	35	20	31	14	—	—	No parasites
65	E	A	Pyrexia	40	27	33	—	—	—	No parasites
66	N	A	Pyrexia	54	28	11	1	6	—	No parasites
67	E	A	Pyrexia	76	4	20	—	—	—	No parasites
68	E	A	Pyrexia	34	19	5	41	8	3	No parasites
69	E	A	Pyrexia	75	11	9	5	—	—	No parasites
70	E	A	Pyrexia	80	8	11	—	1	—	Polychromes
71	I	A	Pyrexia	78	8	14	—	—	—	Polychromes
72	E	A	Pyrexia	81	8	10	1	—	—	No parasites
73	E	A	Pyrexia	64	7	28	—	1	—	No parasites
74	?	?	Pyrexia	67	24	7	2	—	—	Polychromes
75	I	C	Pyrexia	72	8	20	—	—	—	No parasites
76	E	A	Pyrexia	79	3	17	1	—	—	No parasites
77	I	A	Pyrexia	65	5	17	3	10	—	Polychromes
78	E	A	Pyrexia	68	14	17	—	1	—	No parasites
79	I	A	Pyrexia	71	8	16	2	3	—	No parasites
80	E	A	Pyrexia	78	12	10	—	—	—	No parasites
81	E	A	Pyrexia	60	15	23	2	—	—	No parasites
82	N	A	Pyrexia	43	39	13	3	2	—	No parasites
83	E	A	Pyrexia	57	19	12	2	10	—	No parasites
84	E	C	Pyrexia	51	12	25	2	10	—	Bilharziasis
85	?	?	Diff. Count	56	13	28	1	2	—	No parasites
86	N	A	Pyrexia	68	4	27	—	1	—	No parasites
87	E	A	Pyrexia	74	13	13	—	—	—	No parasites
88	E	A	Pyrexia	89	2	8	1	—	—	No parasites
89	E	A	Pyrexia	66	11	21	2	—	—	No parasites
90	E	A	Pyrexia	80	8	10	1	1	—	No parasites
91	E	A	Pyrexia	61	11	25	1	2	—	No parasites
92	E	A	Pyrexia	81	6	12	1	—	—	Polychromes
93	E	A	Diff. Count	71	2	26	1	—	—	No parasites
94	I	A	Diff. Count	79	7	13	—	1	—	No parasites
95	N	A	Diff. Count	58	23	18	—	1	—	No parasites
96	E	A	Trypanosomes	43	8	47	—	2	—	No parasites
97	E	A	Diff. Count	65	26	9	—	—	—	No parasites
98	I	A	Pyrexia	70	10	18	—	2	—	No parasites
99	N	A	Diff. Count	76	9	13	—	1	1	No parasites
100	I	A	Pyrexia	42	21	32	2	3	—	Polychromes
101	E	A	Diff. Count	83	5	10	2	—	—	No parasites

A = Adult. C = Child. Diff. Count = Differential Leucocyte Count. E = European.
I = Indian. N = Native.

APPENDIX VII.

DETAILS OF CASES OF YAWS INVESTIGATED AT KISII.

Case No.	Age.	Sex.	Duration in Weeks.	Site of primary yaw.	Period between primary desion and secondary eruption.	S. pertenue (present + absent —).	Wassermann reaction.	Differential leucocyte						Diagnosis.
								Polymorphonuclear.	Large Mononuclears.	Lymphocytes.	Transitionals.	Eosinophiles.	Mast cells.	
1	4	M	?	Thigh ...	?	+	?	44	20	36	—	—	—	Secondary yaws
2	A	M	12	Leg	4	+	++	51	2	37	—	10	—	Secondary yaws
3	A	M	16	Knee	8	+	++	53	13	25	—	9	—	Secondary yaws
4	A	M	24	Thigh ...	20	+	+	46	8	36	—	10	—	Secondary yaws
5	14	F	8	Occiput ...	3	+	++	29	48	16	—	7	—	Secondary yaws
6	11	F	12	Scalp ...	4	+	++	53	7	36	—	4	—	Secondary yaws
7	A	M	20	Penis ...	16	+	++	50	20	23	1	6	—	Secondary yaws
8	13	M	16	Upper lip ...	?	+	++	56	17	21	5	—	1	Secondary yaws
9	A	F	16	Elbow ...	8	+	++	76	12	7	3	2	—	Secondary yaws
10	11	M	12	Knee	8	+	++	82	7	9	1	1	—	Secondary yaws
11	6	M	?4	Angle of mouth	6	+	++	68	6	24	2	—	—	Secondary yaws
12	9	F	60	?	?	—	++	66	6	25	3	—	—	Tertiary yaws
13	A	M	8	Buttock ...	4	+	++	56	30	10	4	—	—	Secondary yaws
14	A	M	12	Groin ...	3	+	++	57	17	21	—	5	—	Secondary yaws
15	16	F	8	Breast ...	4	+	+±	31	49	15	2	3	—	Secondary yaws
16	16	F	8	Groin ...	4	+	++	36	13	49	—	2	—	Secondary yaws
17	5	M	12	Leg	8	+	++	55	28	16	—	1	—	Secondary yaws
18	8	F	8	Forehead ...	?1/3	—	+±	58	14	24	—	4	—	Secondary yaws
19	8	M	4	Axilla ...	1/3	+	++	66	5	19	—	10	—	Secondary yaws
20	A	F	M'ths.	?	—	—	++	60	9	30	—	1	—	Tertiary yaws
21	A	F	12	Nipple ...	8	—	++	61	12	19	—	6	2	Secondary yaws
22	A	M	12	—	?	—	0	31	39	30	—	—	—	Doubtful. Not yaws
23	A	F	Years	?	?	—	++	71	21	8	—	—	—	Tertiary yaws
24	7	F	8	Angle of mouth	4	+	++	40	22	33	—	2	3	Secondary yaws
25	A	F	12	Thigh ...	?	+	++	—	—	—	—	—	—	Secondary yaws
26	A	M	12	Penis ...	8	+	0	51	26	23	—	—	—	Secondary yaws
27	14	F	4	Thigh ...	2	+	++	82	10	5	—	2	1	Secondary yaws
28	8	F	8	Thigh ...	4	+	++	68	6	22	—	4	—	Secondary yaws
29	18	F	—	—	—	—	++	58	21	17	4	—	—	Doubtful. ? Tb.
30	A	M	8	Knee	3	+	++	60	27	13	—	—	—	Secondary yaws
31	A	F	8	Knee	4	+	+±	80	12	8	—	—	—	Secondary yaws
32	8	F	4	Hand ...	½	+	++	42	6	43	1	8	—	Secondary yaws
33	A	F	12	Face	4	+	+±	66	10	24	—	—	—	Secondary yaws
34	A	M	12	Finger ...	10	—	?	45	6	42	2	5	—	Secondary yaws

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Annual Report

GOVERNMENT BACTERIOLOGICAL LABORATORY
COLONY AND PROTECTORATE OF KENYA.

1921.

I.—ORGANIZATION.

Dr. Kauntze returned from leave on September 16th and resumed the duties of Senior Bacteriologist, which up to that time had been carried out by Dr. Clearkin. The post of second Assistant Bacteriologist was filled by the appointment of Dr. Allen, who commenced his duties on March 11th. In November Dr. Hunter, of the Sanitation Division of the Medical Department, was attached temporarily to the Laboratory for duty, and remained there to the close of the year. The senior non-European laboratory assistant went on leave on February 23rd and returned to duty on May 31st. The second non-European laboratory assistant returned from leave on May 31st.

As the provision of a new laboratory has become a matter of decreasing probability owing to the increasing financial stress in the Colony, it has been found necessary to make alterations in the existing buildings to provide adequate accommodation for the increased staff. The old general office has therefore been converted into a laboratory and office for the Senior Bacteriologist, and his former office used as a workroom for one of the assistant bacteriologists and any medical officer temporarily attached for duty. The clerical staff has consequently been housed in a small room previously used as a store. Various improvements have been carried out in the calf sheds, as will be noted on a later page. It is hoped to reorganise the office staff and methods during 1922 so as to allow of the engagement of a shorthand typist, which will reduce the work of the bacteriologists considerably and set them free for more important duties than writing correspondence out in longhand so that the Goan clerk can type it out correctly. The erection of the ice plant will probably be carried out during the course of the coming year and this will reduce the time spent on the production of calf lymph by the saving of lymph at present unavoidably wasted owing to defective methods of storage.

The remarks made in my report of 1919 with regard to the necessity of the provision of a well-equipped and well-staffed laboratory to deal with the medical problems of the country still hold good, and I see no prospect of any really effective advance in the treatment and prevention of disease till the Medical Department is linked to such a laboratory. Routine clinical work and the production of calf lymph occupy most of the time of the staff, while problems of great economic importance to the Colony and Africa as a whole remain unsolved. Research has not yet come to its own in this country, and obvious revenue-producing investigations are more welcome than those whose utility is only discerned by a few far-sighted individuals.

2.—REPORT ON THE YEAR'S WORK.

A summary of the work done in the Laboratory during the year will be found in Appendix I. It is unfortunate that in a report such as this, it is impossible to record much of the minor research accomplished by the Laboratory staff, and it thus becomes only a record of routine work done. For the first time since the close of the war, two bacteriologists have been on duty together for a considerable portion of the year, and although the figures of examinations done do not reflect this fact, it has enabled more time to be devoted to each investigation, and to the production of a calf lymph which is not only satisfactory in taking properties but also tested before issue as to activity and as to its bacterial content. Dr. Allen, who is responsible for the production of calf lymph, had the advantage of two visits to the Government Lymph Station at Hendon. On his arrival here he was able, from his personal observations and from the advice kindly given by Dr. Blaxall, the Director of the Hendon Station, to suggest improvements in the technique. These are described by him in the next section of the report. The remaining routine work has followed more or less the lines laid down in former years, but various side issues have been investigated, partly with a view to improving the methods in use and partly to satisfy ourselves that the statements made by other workers are correct for this part of the world, for example, the effect of the air temperature and of the sun on a guinea-pig's body temperature has been tested in connection with the response to inoculation of pathogenic bacilli or viruses.

A.—THE PREPARATION OF VACCINE LYMPH.

(I)—SEED LYMPH.

(*a*) LISTER INSTITUTE LANOLINATED SEED LYMPH.

For the first six months Lanolinated Seed Lymph, from the Lister Institute, was used entirely, but the results were not satisfactory. The seed lymph took some time to get to Mombasa, there were difficulties in transit from Mombasa to Nairobi, and storage in the Laboratory was not satisfactory. Then the lanolinated lymph itself, when planted out on agar, always gave an innumerable number of colonies per loopful and its keeping qualities were not good.

(*b*) BOMBAY GLYCERINATED LYMPH.

One of the Indian laboratory assistants, when returning from leave in India, brought back a tube of Bombay Glycerinated Lymph. This was used to vaccinate two calves which yielded 2·0 and 7·7 grammes of pulp respectively. The lymph from these was used to vaccinate eight more calves, of which one gave a yield of 17 grammes, one of 3·8 grammes, and one of 7·7 grammes, while the remainder failed completely. Lymph made from selected vesicles from the 17 grammes yield was used as seed lymph for six more calves and all failed except one, which gave 9 grammes of poor quality pulp. Two more calves were vaccinated with no result, and two rabbits also failed, so the strain has not been tried further.

(*c*) ZANZIBAR STRAIN.

An outbreak of small-pox occurred in Zanzibar in October, 1921, originating from Bombay. Through the courtesy of the Medical Officer of Health, Zanzibar lymph was obtained from the vesicles of a patient. The Medical

Officer of Health selected a case of moderate severity with a profuse rash, discrete in type, and terminating in recovery. The serum was taken from non-purulent vesicles on the seventh day, drawn up into twenty-four capillary tubes, packed in Thermos flasks with ice, and dispatched to Nairobi on 5th October, 1921. The flasks did not arrive in Nairobi until 14th October, and unfortunately were broken in transit. Calf Nos. 185 and 186 were vaccinated the same day, and five days later 1·4 grammes of pulp was taken from calf No. 185, calf No. 186 giving no yield. No vesicles formed on calf No. 185, the only result being some slight thickening and œdema of the incisions. Two days later rabbit No. 14 was vaccinated with lymph No. 185, and 16 poor vesicles developed, which were removed and emulsified, and the same day calf No. 195 was vaccinated from the resulting lymph. The yield was again poor, 5·9 grammes of pulp being obtained. From this two calves were vaccinated, one of which (192) gave a yield of 13·2 grammes of excellent quality pulp, the vesicles being firm and in almost unbroken lines. From the other (199), selected vesicles were taken. The strain has now been carried through 11 rabbits and 33 calves. A table showing the history of the strain to date is given overleaf.

The failures with the Zanzibar strain were due to the use of very poor calves, healthy calves not being available towards the end of the year owing to drought.

The first transfer from rabbit to calf generally gave a poor result, but the pulp from the transfer to the next calf as a rule was good.

Some of the calves gave very good vesiculation, No. 232 giving a yield of 27·8 grammes of pulp. The results were more uniform after the fourth transfer, the earlier transfers, with two exceptions, giving poor visculation.

(*d*) Belgaum Seed Lymph.

Seed lymph was obtained from the Vaccine Institute, Belgaum, India. The results were very uneven. Six calves and one rabbit were vaccinated. One calf, No. 197, gave a good yield, and all the others failed completely. From the calf No. 197 two calves were vaccinated, one giving a good yield, the other failing. Five transfers were then made with fair results, but after this the strain gave poor vesculation and two rabbits were used for rejuvenation, with marked success.

(II)—PREPARATION OF CALF LYMPH.

(*a*) The Supply of Calves.

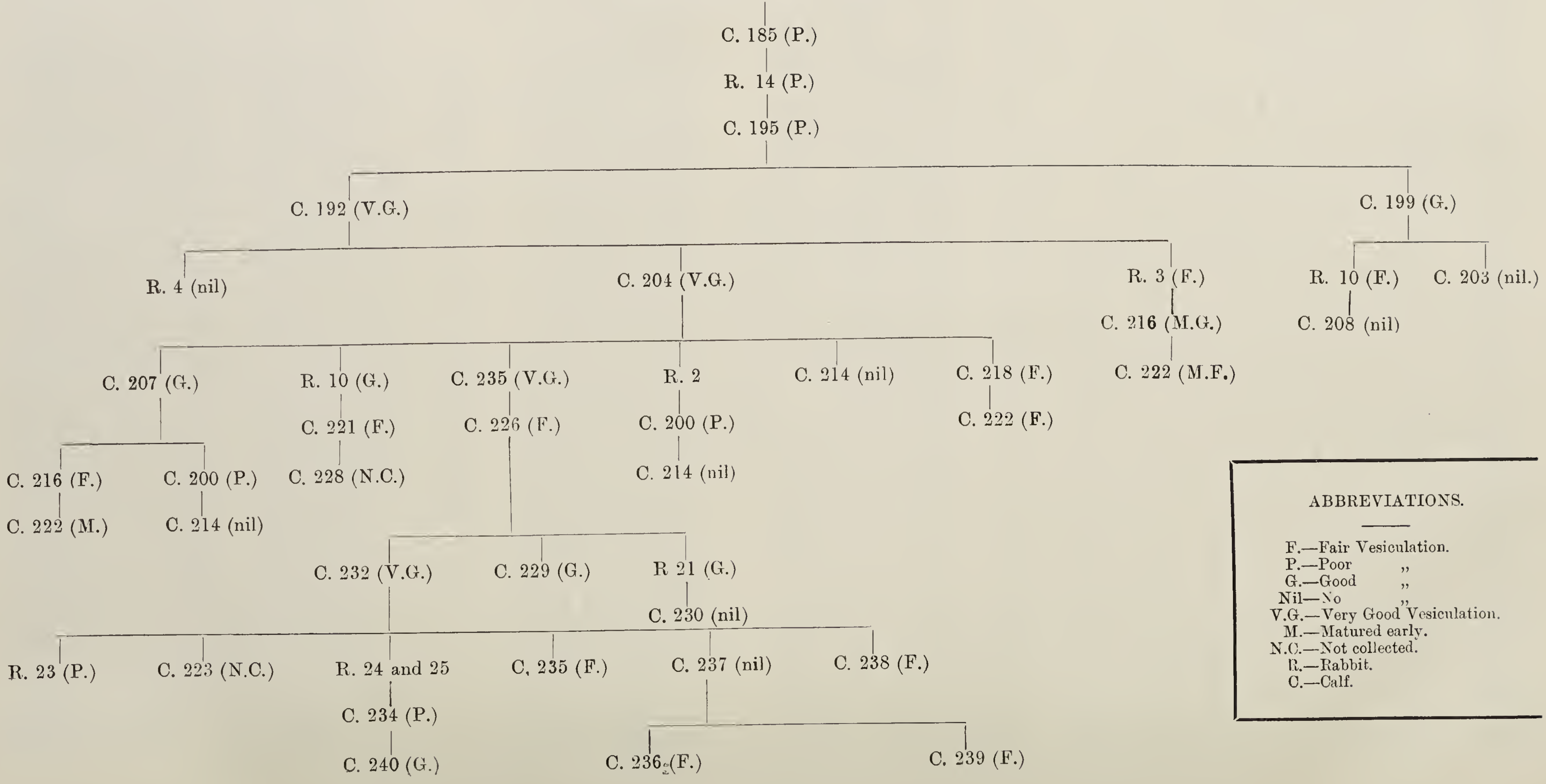
Calves are obtained from the natives through the District Commissioner. They are supplied on the hire system, Sh. 10s. for the use of each calf. Should a calf die while in use in the Laboratory, compensation is paid at the rate of Sh. 150s. per calf. These prices were fixed by the District Commissioner.

As far as possible the calves are selected, white heifers from six to twelve months old with unpigmented abdomens being taken. There are many difficulties, however, for the natives object to their calves being used for vaccination, East Coast Fever was prevalent in the district of supply throughout the year, and the calves were usually in poor condition when brought in owing to the scarcity of food due to the drought. On a good many occasions the majority of calves offered were quite unsuitable for vaccine purposes, but had to be used to keep up the supply of calf lymph.

TABLE I.

ZANZIBAR LYMPH STRAIN.

Serum from Smallpox Vesicles.



ABBREVIATIONS.

F.—Fair Vesiculation.
P.—Poor "
G.—Good "
Nil—No "
V.G.—Very Good Vesiculation.
M.—Matured early.
N.C.—Not collected.
R.—Rabbit.
C.—Calf.

It is hoped that when the refrigerating plant is erected during the coming year, these difficulties will be largely overcome, as it will then be possible to obtain calves when the grazing is at its best, so that there will probably be fewer failures and so fewer calves will be necessary.

(*b*) Housing of Calves.

During the second half of the year calves waiting to be vaccinated were kept in a shed in the Quarantine Hospital, and grazed over the surrounding plains. While there, they were dipped twice a week in the municipal dip. Notwithstanding this, 15 calves died during the year of East Coast Fever.

Several alterations were made in the calf shed in 1921.

(1) Two sets of floor boards were made for each stall.

(2) Wooden gates, having a space between sufficient for a calf's neck to move up and down in, were put up in each stall.

(3) Hay racks were provided in each stall.

(*c*) Feeding of Calves.

The calves were fed on crushed maize and fresh grass. Cocoanut oilcake has been tried, but has not proved very satisfactory as the calves are not kept in the Laboratory long enough to become accustomed to a strange food.

(*d*) Preparation of Calves for Vaccination.

The calves are brought down to the Laboratory three to four days before being vaccinated. They are thoroughly washed and groomed and kept in the waiting shed. The evening before vaccination their abdomens are shaved. The Belgaum method of applying glycerin after shaving was tried for a while, but did not seem to give any advantage, so it has been stopped.

(*e*) Vaccination of Calves.

The calves are placed on the operation table and the shaved area thoroughly washed with soap and water. The abdomen is then sprayed with sterile water, and dried with sterile swabs. Vaccination is performed with a scalpel. The incisions are made about 6 inches long with an average number per calf of 36. Three incisions are made at a time and the seed lymph inserted with an instrument made locally for the purpose. It is six inches long and made of polished steel, tapering to a point, the end being ball-shaped and having a diameter of $\frac{1}{16}$ of an inch. Three grooves are cut above the ball-shaped end running in the long axis of the instrument. When in use the sterile vaccine inserter is dipped into the vessel containing the seed lymph and applied along the incision, the grooves in the steel retaining enough lymph to inoculate one incision.

(*f*) Care of Vaccinated Calves.

During the first part of the year, aprons were used on the calves to protect the vaccinated area, but when the floor boards and gates were made, aprons were discarded as unnecessary. With native attendants only, it is very difficult to keep aprons clean, and if a calf wears a badly soiled apron all night the result on the vaccine pulp is worse than if no apron had been in use. The floor boards are taken out every morning at 7 a.m., scrubbed and left in the sun for the day and the duplicate set put in the stall. At 4 p.m.

these boards which are now soiled are taken out and cleaned, and replaced by the dry boards cleaned in the morning. A boy is on duty all day to keep the floor-boards in use clean, and the sheds are inspected at night by the head boy.

The vaccinated area is inspected daily, and when the vesicles are mature the lymph is collected. This usually occurs after about 120 hours.

(*g*) COLLECTION OF PULP.

The calf is put on the table, and the vaccinated area washed with sterile water and dried. The vesicles are inspected and their quality noted in the record book. Quality is classified as follows :—

(1) + + + + Lines of vesicles unbroken and with a straight margin.

(2) + + + Lines of vesicles unbroken but with a wavy margin.

(3) + + Lines of vesicles with indented margins and also discrete vesicles.

(4) + Discrete vesicles only.

First quality vesiculation is rarely seen, probably because the calves used are not sufficiently healthy.

Second quality vesiculation is fairly common.

Third quality vesiculation is commonest.

Fourth quality vesiculation is collected only when the vesicles are in fair numbers and of healthy appearance.

The lines of vesicles are removed with a Volkmann spoon, care being taken to remove the base. The pulp is placed in sterile Petri dishes and labelled with the calf's number. The collection of pulp from each calf is kept separate, and retains its individuality when made into lymph.

TABLE II.

(*h*) RESULTS OF CALF VACCINATION.

No. Vaccinated.	No. Successful.	No. Failed.	Average Yield.	
			For each calf successfully vaccinated.	All Calves.
			grammes	grammes
226	91	135	12·3	4·3

The results for the first six months were very poor. The seed lymph was not good and the calves were not in good condition..

With an improved seed lymph, the yields became much better in quantity and quality of vesiculation, especially the latter. White calves and calves with unpigmented abdomens gave very much better vesiculation than black or grey calves. This was most evident when a calf with a partly pigmented abdomen was vaccinated. The vesiculation on the non-pigmented areas, especially near the groin, was often very good. On the portions of the incisions on the pigmented skin the vesicles were poor or absent.

Some large yields were obtained during the last six months of the year, the largest being 27·8 grammes, and yields of 12 to 20 grammes were very common. When the vesicules were of good quality, the lymph gave good vaccination results, the insertion rate and the success rate being almost equal, so that the quality of the vesiculation is the real determinant of the value of the vaccine, and a large yield does not necessarily imply a lymph poor in taking properties.

The number of failures was large, and while the condition and colour of the calves and the quality of the seed lymph account for many of these, they do not explain all the failures. Sometimes several apparently suitable calves would be vaccinated with the same seed lymph on the same day, and while one or two of the calves gave very good vesiculation, the others failed. The reason for this is not understood at present.

(*i*) PREPARATION OF THE EMULSION.

The sterile Petri dishes containing the pulp are brought to the weighing and grinding room. The weight of glycerin solution used is four times the weight of pulp, and is a mixture of equal parts of pure glycerin (Burgoyne and Burbridge's Glycerinum pur. S.G. 1·260), and distilled water titrated to Ph. 7·4 by a colorimetric method of hydrogen ion concentration estimation.

The pulp is ground with the glycerin solution by passing it three to four times through a Chalybæus machine (Blaxall's modification). The glycerin and pulp are placed in the hopper of the machine in small quantities until all has been ground. The resultant emulsion is passed through the machine again and again until it is judged to be thoroughly ground and mixed.

(*j*) STERILIZATION OF THE EMULSION.

Three methods have been tried during the year.

(1) *Blaxall's Clove Oil Method.*—0·1 per cent. clove oil was added to the 50 per cent. glycerin solution in distilled water. The results were uncertain, large numbers of organisms frequently being present even after a month's storage. As the lymph could not be retained sufficiently long to obtain its sterility, the method was discontinued. Another difficulty encountered in this method was the thorough mixing of so small a quantity of clove oil with a liquid like glycerin. The latter trouble could be overcome by mixing the clove oil and glycerin in bulk.

(2) *The Glycerin was Diluted with an equal quantity of Chloroform Water.*—This method gave very satisfactory results as regards removal of extraneous organisms, but it is believed that the lymph suffered in activity. The number of organisms always fell below ten per loopful in fourteen days to three weeks and shortly after this the lymph was invariably sterile.

(3) *The Belgaum Chloroforming Process.*—This is described by Fisher in the Indian Journal of Medical Research for October, 1920. This process was first used in August, 1921, and the results have been very satisfactory. The lymph is ready for issuing within a week of removal from the calf and apparently remains active for a long period. It has the great advantage of removing the majority of the extraneous organisms with very little, if any, loss of activity of the lymph, probably because the disinfectant is completely removed immediately, and so does not remain in contact with the lymph virus, as was pointed out by Fisher. This is the method at present in use in the Laboratory.

The procedure employed is as follows :—

A water blast pump is used to produce the necessary current of air which first passes through an empty Woulff bottle, then through a glass tube containing cotton wool, and then into a Woulff bottle containing chloroform (Duncan and Flockhart's). Chloroform vapour and air then pass through a bottle containing sand sterilised in a hot-air oven for three hours at 110° C., which removes any moisture, and from thence the vapour passes through the lymph which is contained in the large test tubes. The whole apparatus, with the exception of the sand bottle, is sterilised in an autoclave. Chloroform vapour is bubbled through the tubes of lymph for twenty minutes to half an hour, the time depending on the quantity of lymph. The chloroform and sand bottles are now removed and air only is bubbled through the lymph for three hours, the tubes after the first fifteen minutes being kept in an ice box at a temperature of about 8° C.

On completion of the sterilising process the lymph is transferred to smaller sterile tubes, and a loopful is planted out on an agar slope, after which the tube is corked with a sterile rubber bung and the top paraffined.

The number of colonies on agar per loopful immediately after chloroforming vary from 4 to 40 and within a week the colonies are almost always below 10 per loopful. Before issue each batch is examined for Bacillus tetanus, using an anærobic stab culture in glucose agar, and for ærobic pathogenic organisms. Lymph batches in stock are tested by planting out on agar slopes every week and they remain almost sterile.

(*k*) Bacteriology of Lymph.

Ærobic and anærobic cultures were made at regular intervals. B. tetanus was never found. The main organisms seen were :—

(1) Staphylococcus albus—the commonest.

(2) Staphylococcus aureus.

(3) A Gram positive bacillus resembling B. subtilis.

(4) Rarely a Gram negative bacillus non-pathogenic to guinea-pigs.

(III)—LABORATORY VACCINATIONS.

(*a*) Source of the Material.

268 persons were vaccinated in the Laboratory and used to control the activity of the lymph before it was issued to the various stations. This number was made up as follows :—

224 Police from the Police Depôt.
37 Staff and patients of the Infectious Diseases Hospital.
7 others.

Through the courtesy of the officer in charge of the Police Depôt, 12 police were sent to the Laboratory every Saturday. They came with unfailing regularity, and without the co-operation of this officer the satisfactory control of lymph activity would have been impossible.

(*b*) Routine.

The Police were vaccinated on Saturday morning and seen again on Tuesday and again on the following Saturday. Each batch of lymph was used to vaccinate several men before issuing, and if not active after several vaccination tests the batch was discarded.

Unfortunately out of the 244 men vaccinated, only 19 had not been previously vaccinated, while a few were doubtful. The remainder had been vaccinated before, the majority of these several times. Notwithstanding this the number of vaccinated cases which were completely unsuccessful was only 44. Twelve were not seen again after vaccination.

The value of seeing the vaccinated on the third day was very evident. Some men who were revaccinated, showed on the third day an accelerated reaction with rows of very small but very distinct vesicles along the lines of scarification, but in 75 cases these vesicles had completely disappeared by the eighth day, although other men vaccinated on the same or a later date with the same lymph and under the same conditions had well-formed vesicles on the eighth day and gave a typically successful result. Three months later several of these men whose vaccination had aborted were again vaccinated with active lymph and all failed completely. The explanation may be that where a partial immunity already exists the reaction is accelerated and nothing can be seen after the fifth or sixth day, for no signs of the slight vesiculation remain and if the men had not been seen on the third day it would not have been suspected. This abortive vaccination, though very interesting, made it difficult to gauge the activity of the vaccine lymph. If there was any doubt about the activity of a lymph batch it was not issued until a control gave four areas of well-formed vesicles as the result of four insertions of lymph in four separate areas on the arm or leg.

(*c*) TECHNIQUE OF LABORATORY VACCINATIONS.

(1) The arm was scrubbed with soap and water, all soap removed with fresh water, and the arm allowed to dry.

(2) Ether was sometimes used to clean the arm after washing, but was not employed as a routine measure, as it was considered desirable to vaccinate as far as possible under the same conditions as in an out-station where several hundred people might have to be dealt with in a day.

(3) Straight surgical needles, No. 1 size, were used for making incisions. Each needle was boiled after use, and placed in a small dish containing sterile water. The lymph was inserted with the rounded end of a King scarifier. Four sets of scarifications were made 1 inch apart. Each set was made up of four incisions, $\frac{1}{6}$-th inch long and $\frac{1}{16}$-th inch apart. The needle was held perpendicularly to the skin and the skin sharply incised till the moist pink surface of the cutis vera was visible. Blood was not drawn. The needles were kept very sharp as it is essential that the edges of the incision should be injured as little as possible. No covering was employed, the men being kept indoors until the lymph had dried on the arm completely.

(*d*) POLICE VACCINATION RESULTS.

Number vaccinated	244
3rd day.	
Number showing small well-formed vesicles ...	114
Number showing very slight vesiculation or slight reaction	49
No. showing no reaction	46
Number not seen	11
Total ...	220
8th day.	
Successful vaccinations	67
Poor vesiculation	23
Abortive vaccination (*i.e.*, vesiculation on the 3rd day, nil on 8th day)	75
Failures (no reaction seen on 3rd or 8th day) ...	44
Number not seen	11
Total ...	220

Twenty-four police were vaccinated by the intracuticular method. On the third day 21 showed a reaction consisting of slight swelling, tenderness and vesicles at the point of innoculation, 2 were doubtful, and 1 was not seen.

On the eighth day some showed vesiculation and swelling, others nil. Three of these men were vaccinated six weeks later by the ordinary method and gave negative results.

(*e*) Other Vaccinations.

Thirty-seven of the staff and patients of the Quarantine Hospital were vaccinated.

TABLE III.

No. Vaccinated.	Successful.	Failed.	Not Seen
37	17	12	8

(IV)—STORAGE AND DISPATCH OF LYMPH.

(*a*) Storage.

Lymph is stored in the Laboratory in an ice chest, the temperature of which varies from 8° C. to 18° C., depending on the number of times the chest has to be opened during the day. The lymph remains active in the ice chest for several weeks, the time depending on the initial quality.

A new ice chest was made in July. The former ice chest was very old and the temperature rarely fell below 16° C. Lymph was stored in it in Erlenmayer flasks with a cotton wool plug and a large quantity of it had to be destroyed in April, May and June, owing to fungus contamination. The lymph is now stored in large test tubes with a rubber bung, and is filled within one inch of the top, and the bung paraffined. Owing to this and also to the fact that the temperature of the new ice chest is lower than that of the old, no lymph has been contaminated with fungi since July. Lymph is issued as a rule after three to six weeks' storage.

(*b*) Filling of Lymph into Capillary Tubes.

All lymph is dispatched in capillary tubes, each tube holding sufficient to vaccinate three persons.

Five c.c. of lymph are taken out of each batch before filling and kept in the Laboratory for reference, in the event of any unsatisfactory reports being received. The remainder is poured into a sterile beaker and a modification of Entrican's machine used for filling, viz., a Bruhl's jar through the lid of which a rod moves in a verticle direction. To this rod the capillary tubes (sealed at the upper end) are hung in a bundle kept together by two rubber bands. Lymph is placed in a vessel in the jar below the tubes. The jar is exhausted with a Geryk vacuum pump and the tubes then lowered so that their open ends dip into the lymph. When air is admitted into the jar the lymph rises into the tubes. The sealing of the tubes is done with a spirit lamp, one tube at a time, and the tubes are immediately put on ice.

(*c*) Methods Used for Dispatch of Lymph.

(1) *Packing in Wooden Boxes with Ice and Sawdust.*—This is very satisfactory if the distance the lymph travels is not too great.

(2) *Thermos Flasks.*—The great difficulty with Thermos flasks is that they are so easily broken unless carried by hand. The capillary tubes of lymph are put in test tubes, each tube holding fifty to sixty capillary tubes. The test tubes are then put into the flask and firmly packed with sawdust and ice. The flask is put into a wooden box having a thick pad of felt at the bottom, a spring round the sides lined with felt, and a sliding lid. Practically every flask sent out got broken during its first or second journey. Packing boxes in a basket, well padded with tow, was also tried in the hope that the padding would absorb some of the shock, but the two boxes send out in this way also got smashed. At present a box is being made with well-padded sides and a spring at the bottom and on the lid which hinges over and is strapped down. It is hoped that this will prove more successful.

All lymph for the Nyanza Province is sent to the Medical Officer of Health, Kisumu, who sends supplies when required to Kakamega and Kisii. It is kept in an ice box in Kisumu until dispatched. Similarly the Medical Officer of Health, Mombasa, distributes lymph to Kismayu, Lamu and other stations.

(V)—DRIED LYMPH.

(*a*) Locally Manufactured Dried Lymph.

This was issued to Lamu and the Frontier Stations during the first six months of the year. The lymph was put up in ampoules in vacuo. A large number of ampoules were broken in transit and the lymph lost. Glycerinated lymph is now being sent to all stations.

(*b*) Blaxall's Dried Lymph with Myrrh.

Dried lymph with myrrh was sent out from England via South Africa by Dr. Blaxall in single and double vacuum tubes. The lymph travelled in an ordinary cabin trunk and was two months in transit. Several tubes arrived broken. On arrival four police were vaccinated with lymph from both single and double vacuum tubes. Two of the four police were vaccinated as follows :—

Two scarifications were inoculated with Dr. Blaxall's lymph and two with stock lymph. No vesiculation occurred with the dried lymph and myrrh in any case. In one of the controlled cases one poor vesicle developed on the third day with stock glycerinated lymph. The second case showed two good vesicles with stock glycerinated lymph. The results from Dr. Blaxall's lymph was nil. One calf was vaccinated from the dried lymph.. The calf was light brown in colour, about 12 months old, and in fair condition. One-half of the abdomen was vaccinated with dried lymph from a single vacuum tube, and the other half with dried lymph from a double vacuum tube. Both failed completely.

All other patients and calves also gave no result with vaccination with the dried lymph, so that it may be concluded that the dried lymph on arrival was inactive. It should be noted that no special precautions were taken to protect the lymph from heat, and the test to which it was subjected was therefore a severe one. It is hoped that experiments on the transmission of dried lymph, and its power of retaining activity, will be continued during the coming year.

(VI)—VACCINATION RETURNS.

(*a*) Laboratory Issues of Calf Lymph.

Number of doses issued by Laboratory :—

(*a*) Glycerinated lymph	66,162 doses.
(*b*) Dried lymph	17,300 doses.
Total No. doses issued	83,462

The lymph was issued as follows :—

Kenya Colony and Protectorate ...	80,442 doses.
Zanzibar	2,820 doses.
Seychelles	200 doses.

(*b*) Summary of Returns Received.

This return is compiled from the returns sent to the Chief Sanitation Officer and from the Laboratory returns. (See Appendix II).

Kenya.

No. of doses issued	80,442
No. of persons vaccinated	58,909
Successful vaccinations	7,565
Unsuccessful vaccinations	3,700
Results unknown	47,644
Percentage case success rate	68 per cent.

Seychelles.

No report was received.

Zanzibar.

No. of doses sent	2,820
No. of persons vaccinated	2,046
No. of successful vaccinations	224
No. of unsuccessful vaccinations	1,400
Results unknown	422

(The unsuccessful results were among the re-vaccinated.)

Reports were received at the Laboratory for 47,206 doses issued. The fate of the remaining 36,256 doses is unknown. Only 11,265 people were seen after vaccination out of a total of 58,909 vaccinations. Re-vaccinations have not been distinguished from primary vaccinations in the reports, but the number must have been high, as the majority of those vaccinated were male adults going to work on various farms, the railway, etc.

The figure 68 per cent., taken as the case success rate, is misleading, as there is little doubt that considerable numbers of vaccination results reported are incorrect. The following are some copies of reports which give accurate information and from which some conclusions can be arrived at with regard to the activity of the lymph issued.

TABLE IV.

Report received from and date issued.	Doses issued.	Total No. Vaccinated.	No. observed on 8th day.	No. of successful vaccinations.
M. O. H. Mombasa. 25/7/21	300	290	250	240
M. O. H. Mombasa. 5/9/21	300	27	17	17
M. O. H. Mombasa. 13/9/21	300	56	30	22
Dr. Forbes, Magadi.	20	17	15 results.	15 excellent.
	Total ...	390	312	294

In these reports, 80 per cent. of those vaccinated have been seen, and the success rate is 94·2 per cent. In the returns from some stations the success rate is persistently low. Three factors may be involved in these cases.

(1) *Previous Vaccination.*—As a rule in the towns and stations the majority of the natives are vaccinated. It was very unusual to find an unvaccinated native amongst the police recruits seen in the Laboratory. The primary vaccinations as a rule came from out of the way parts of the Wakamba Reserve. The adult male Kavirondo population is largely vaccinated, as numbers of them were in the Carrier Corps during the war, and for many years all labour leaving the Nyanza Province has been vaccinated in Kisumu. A high percentage case success rate cannot therefore be expected from such material. The vaccinations performed during the year were mainly from—

(*a*) Station hands, prisoners, and natives employed by the Municipality, etc;

(*b*) Natives being registered in the Reserves;

(*c*) Labour going out to shambas.

Of these only the first group, which consists mainly of previously vaccinated individuals, was seen again by the vaccinator. Vaccination in the Reserves, except amongst adult males during registration, has not been carried on during the past year.

(2) *Faulty Technique in Vaccinating.*—This is an undoubted cause of failure in some cases. Some of the more obvious faults are :—

(*a*) The arm is washed with soap and water and the soap is not properly removed, leaving an alkaline deposit on the arm;

(*b*) Unnecessary damage is done to the skin when it is scarified, and this may lead to sepsis.

(*c*) Scarification may be too superficial or too deep;

(*d*) The lymph is rubbed into the scarifications with an instrument which recent sterilization has rendered too hot;

(*e*) The patients are allowed to stand with the vaccinated arm exposed to the sun before the lymph has dried.

(3) *Inactive Lymph.*—Although each lymph number is tested for activity before being issued, there are several fallacies, *e.g.* :—

(*a*) The capillary tubes containing lymph are sealed by African laboratory assistants and, although they are carefully trained and supervised, it is probable that a few tubes in a batch are over-heated. In filling the tubes, the lymph is drawn into them as far from the open end as possible, but all tubes are not equally filled, and with African labour it is impossible to ensure that an occasional tube is not inactivated;

(*b*) The pulp is made up of a certain amount of extraneous material as well as the actual virus, and it may be possible that some portions of the mixture are not as active as others, but this is unlikely as the mixture is passed through the Chalybæus machine several times. Furthermore, Dr. Duke, of Uganda, informed us that he had vaccinated with the clear supernatant fluid from lymph satisfactorily, and it has also been done here with positive results;

(*c*) The lymph may deteriorate in transit, especially to the more distant stations. The time taken on the journey is often considerable and the containers of the lymph tubes are frequently broken. This is probably the most prolific cause of ineffective lymph, and it is hoped that during the coming year experiments now in progress will eliminate this source of trouble to a very large extent.

(VII)—CALF LYMPH EXPENDITURE, 1921.

Total number of doses manufactured	223,300
Total number of doses issued	83,462
Total number of doses used as seed lymph	2,574
Total number of doses in stock	13,400
Total number of doses of the Zanzibar strain lymph manufactured before being suitable for issue ...	29,254
Total number of doses which became inactive or contaminated	94,710
Total expenditure on lymph production	£1,515 13s. 7d.
Cost per dose manufactured	1·63 pence.
Cost per dose issued	4·36 pence.

B—MALARIA.

The incidence of benign tertian malaria still shows the reduction noted in the reports for 1919 and 1920. A comparison of the figures for the last eleven years is instructive as showing the rise in incidence of this form of malaria compared with subtertian malaria during the East African campaign.

TABLE V.

	1911.	1912.	1913.	1914.	1915.	1916.	1917.	1918.	1919.	1920.	1921.
Benign Tertian Malaria ...	25	19	12	10	61	176	607	308	90	44	19
Quartan Malaria	13	13	4	10	22	27	11	7	12	10	4
Subtertian Malaria	238	209	174	218	814	655	881	435	540	224	83

As has been pointed out in previous reports, the rise and fall of the number of benign tertian infections coincides more or less closely with the arrival and departure of the Indian troops who took part in the campaign in this country. Why the infection has not persisted cannot be conjectured with our present knowledge except it be the withdrawal of a large body of reservoir hosts and it will be interesting to see whether a wet year will again increase the number of cases of benign tertian malaria beyond the normal proportion. It will be noted in connection with the weather conditions that the amount of malaria as reflected in blood slides diagnosed in the Laboratory is lower than it has been at any time in the period for which figures are given on p. 148. This is attributable to two factors. Firstly, the year has been one of great drought and comparatively few mosquitoes. Secondly, there has been an increasing tendency on the part of medical officers to examine and report on blood slides taken from their own cases, consequently the slides which have been sent to the Laboratory for diagnosis have been mostly those in which the medical attendant has been unable to find malaria parasites for himself. The relative importance of these factors in determining the low figure for malaria in the Laboratory records cannot be known until a wet season has been passed through and the effect of it on the malaria incidence noted.

A fact to which attention should be drawn is the very small number of subtertian crescent forms seen. Three out of the five cases found this year have been in patients who also harboured benign tertian parasites. Cases of subtertian malaria in which most of the red blood corpuscles are infected are uncommon at present.

One observation which may be of importance is that the blood slides from patients suffering from malaria and coming from the Thika district near Nairobi show plasmodia which conform in most particulars to the typical subtertian ring form but differ in having two large, coarse masses of chromatin which may be situated at opposite sides of the parasite, and in the ring being larger in size than is usual. These features are constant in all the parasites found in the same slide and almost so in the bloods of patients who have actually derived their infection from the district mentioned. It may be remarked that malaria in that district is notoriously of a severe type and is followed frequently by blackwater fever.

C.—SPIRILLUM FEVER.

The cases which were diagnosed in the Laboratory during the year were all natives and these were not dwellers in Nairobi. Most of them came from the Kyambu district and two were recent arrivals from Fort-Hall, which is known to be an endemic centre of the disease. An entomological survey of the country is urgently needed to determine the tick distribution as well as that of the mosquitoes. This might explain why spirillum fever is localised to a few scattered areas of very small size, and why no general outbreak of the disease followed the repatriation of military porters from German East Africa, many of whom undoubtedly returned infected with the Spironema vossi, and, having escaped diagnosis, went back to their Reserves, where, as far as we know at present, the same tick exists as in the districts where spirillum fever is endemic.

D.—HELMINTHIC INFECTIONS.

Comparatively few stools have been received for examination for the ova of helminths during the year. Here again there has been a greater desire on the part of the clinical staff of the hospitals to make their own examinations, and this has been encouraged by us since by the carrying out of such work by medical officers the Laboratory staff is released for more specialised duties. Again infection with Ancylostomidæ heads the list, but it is doubtful if this really represents the true numerical relations of the various infections, for the Ancylostomidæ caused symptoms for which relief is looked for in hospitals earlier and more frequently than any other family of worms, hence in any statistics obtained from patients in hospital, the parasites which cause the worse symptoms will always be more prominent. It is only by the examination of a body of healthy natives such as are found in an Institution or a gaol, that the true proportion of infections with the various intestinal helminths can be found. Unfortunately it is again impossible to state whether the Ancylostomidæ whose ova were seen were Ancylostoma duodenale or Necator americanus, since only a small portion of the patient's stool was sent for examination, and apparently the whole stool was not examined at the hospital for worms after treatment. It is hoped to do something to elucidate this important question during the coming year. From helminths recovered from post mortem examinations and from the comparatively mild symptoms exhibited by patients apparently heavily infected, it is probable that the common infection will be found to be Necator americanus.

In 315 stools examined the following infections were found :—

Ova of Ancylostomidæ in 33 cases	10·5 per cent.
Ova of Tænia saginata in 30 cases	9·5 ,,
Ova of Trichiuris trichiura in 26 cases ...	8·3 ,,
Ova of Ascaris lumbricoides in 12 cases ...	3·8 ,,
Larvæ of Strongyloides stercoralis in 10 cases...	3·2 ,,
Ova of Schistosoma mansoni in 9 cases ...	2·9 ,,

Double infections occurred in 25 cases = 7·9 per cent. They were as follows :—

Ova of Ancylostomidæ and T. saginata ...	6 cases.
Ova of T. saginata and T. trichiura	5 ,,
Ova of A. lumbricoides and T, trichiura ...	4 ,,
Ova of Ancylostomidæ and T. trichiura ...	3 ,,
Ova of A. lumbricoides and T. saginata ...	2 ,,
Ova of A. lumbricoides and larvæ of S. stercoralis	1 case.
Ova of Ancylostomidæ and larvæ of S. stercoralis	1 ,,
Ova of T. saginata and larvæ of S. stercoralis ...	1 ,,
Ova of Ancylostomidæ and A. lumbricoides ...	1 ,,

Triple infections occurred in 2 cases = 0·6 per cent. They were as follows :—

Ova of Ancylostomidæ, A. lumbricoides and T. trichiura	1 case.
Ova of Ancylostomidæ, T. trichiura and larvæ of S. stercoralis	1 ,,

Quadruple infection occurred in one case = 0·3 per cent. It was as follows :—

Ova of Ancylostomidæ, A. lumbricoides, T. saginata and S. mansoni	1 case.

Comparison of the figures for Schistosoma mansoni infections for the last three years shows that, although the actual number of cases observed has decreased, the percentage borne to the total number of stools examined for ova has steadily increased; thus in 1919 it was 1·8 per cent, in 1920 it was 2·4 per cent. and in 1921 it was 2·9 per cent. of all specimens investigated. The figures, however, are not sufficiently large to justify any conclusion as to the increase or otherwise of the prevalence of this infection amongst the population. It is hoped to continue investigations into the presence of infected snails in the various local waterways during the coming year. It is worthy of note that rectal bilharziasis is much more common in this country than the urinary type.

It is generally assumed that infection with Trichiuris trichiura causes no symptoms unless present in large numbers. One case that occurred in an European child during the year under consideration tends to disprove this statement. The child was anæmic, had a poor appetite and slept badly. Examination of the stools showed scanty T. trichiura eggs. Two doses of oil of chenopodium at ten day intervals resulted in rapid improvement of the patient and the complete disappearance of the ova from the fæces.

One point that may be of interest is that, in spite of the large number of natives who are found to be infected with intestinal parasites, the number of blood slides from Africans which show eosinophilia is very small. An investigation of the relation between eosinophilia and helminthic infection might well be carried out by a medical officer in charge of a gaol or similar institution.

E.- PSEUDO DIPHTHERIA.

Two cases occurred during the year which clinically gave all the symptoms of diphtheria. One of these patients was a child with dyspnœa so acute as to call for immediate tracheotomy. A thick membrane was found in the throat which in a smear showed an organism having long branched mycelial threads with budding forms, but no bacilli resembling those of diphtheria. This fungus after several subcultures was isolated in a state of purity. On Sabouraud's agar it gave a profuse creamy white growth. There was no liquefaction of gelatine, and in litmus milk the organism produced acid but no clot in seven days. It fermented glucose, lævulose, maltose and saccharose with the production of acid and gas, but with galactose only acid was formed in the later subcultures, although there was doubtful gas formation in the earliest subcultures. This is perhaps explained by Castellani and Chalmers' statement in their text book of tropical medicine that Monilia may lose some of the fermentative action on galactose after several subcultures. The fungus isolated from the case under discussion was not pathogenic to guinea-pigs. From a consideration of its actions on gelatine, milk and sugar broths and from its morphological characteristics, it is probable that this organism was Monilia tropicalis or a closely allied fungus in spite of its non-pathogenicity for guinea-pigs.

F.—LEPROSY.

A case of leprosy was seen whose arms were covered with bullæ, which on puncture exuded a thick dark brown fluid. Microscopical examination of smears made from this fluid showed it to contain large masses of Bacillus lepræ.

G.—WASSERMANN REACTIONS.

Early in the year the method previously in use in this Laboratory was abandoned and that described by the Medical Research Committee in their Special Report, Series No. 14, page 36, substituted with very satisfactory results. The main difficulty experienced in Kenya is to obtain complement of a sufficiently high titre. This seems to be associated with the similar difficulty experienced in obtaining sera of high agglutination titre by inoculation of rabbits. It was noticed that the complement worked better in cold weather than in hot, and the guinea-pigs are now kept for two days prior to the withdrawal of blood for complement in a cool chamber at about 17° C. This has resulted in a more powerful complement being obtained as a regular occurrence. A trial was given to Donald's drop method as applied to the Wassermann test. It was found that if there were a large number of sera to be examined the drop method resulted in a gain in speed and accuracy, but when the number of sera was small the gain was counterbalanced by the large wastage in hæmolytic serum, and complement that occurred, while graduated pipettes gave a result inappreciably different from a practical point of view.

Several opportunities have now occurred of testing the blood of patients who have just returned to the Colony from England and who have had a Wassermann test carried out shortly before leaving London. The results obtained here have shown practically complete correspondence with the English results.

H.—AGGLUTINATION REACTIONS.

It has been frequently noted in previous reports that Widal reactions are often negative even in cases which clinically are undoubtedly enteric fever. During 1921 a considerable amount of the time of the Laboratory staff was spent in the attempt to produce high titre immune sera for the typhoid-paratyphoid group of organisms. The attempt was finally successful but all the recommendations given by authors working in European laboratories were found to be inapplicable in Kenya. Thus it is stated that 0·5 c.c. of a killed 24-hour broth culture inoculated intravenously and followed on the fifth or sixth day by the same or a slightly larger dose, will usually yield a serum of adequate titre by the tenth or eleventh day. This and similar small doses were tried but never gave a serum with a higher titre than 1 in 10. The size of the doses was increased, and it was eventually found that three doses of 5,000 million bacteria from an agar culture emulsified in 2 c.c. of a 0·5 per cent. solution of carbolic acid in normal saline given at six day intervals produced a serum with a titre of about 1 in 2,000 ten days after the last inoculation. This failure of agglutinin production may have some bearing on the comparatively frequent absence of the Widal reaction in typhoid fever.

The result of a series of agglutination reactions against B. proteus X 19 carried out on 93 natives in the Native Civil Hospital, Nairobi, will be found in Appendix 3.

I.—DISEASES RESEMBLING TYPHUS FEVER.

An account by Dr. Clearkin of a series of cases with symptoms allied to a mild form of typhus fever will be found in Appendix 3.

J.—VACCINES.

The majority of the autogenous vaccines made during the year have been from organisms of the B. coli group for conditions usually described under the term "rheumathoid arthritis." In Appendix 4 will be found a note on the use of these vaccines and the results up to date, and from this it will be seen that the hopes expressed in the annual report for 1919 have been justified. This year the diseases for which the vaccines have been found useful have been extended and it now remains to discover the extent to which infection with the organisms of the coli-typhoid group or absorption of their toxins from the bowel is responsible for definite pathological conditions and for those indefinite ailments best described as malaise.

Three cases of pyhorrhœa were treated with autogenous vaccines prepared from pus taken from pockets in the gum round the teeth. These vaccines contained a mixture of a staphylococcus, a short streptococcus and Micrococcus catarrhalis, and the result of the inoculations combined with dental treatment was apparently a complete cure in each case.

T.A.B. vaccine was manufactured this year from bacteria grown on agar slopes and emulsified in a solution of 0·5 per cent. carbolic acid in normal saline instead of from broth cultures as was done previously. The result has been most satisfactory, for the local reaction following inoculation is much diminished.

K.—WATER SUPPLIES.

Twenty-six waters of various kinds were examined during the year. This is a considerably smaller number than in former years and is due to the paucity of the Laboratory staff, which resulted in waters being crowded out by more important work from February to July, and to only one soda water being submitted by the Health Officer for examination. An examination of the water supply of the British East Africa Fibre Company factory at Masongaleni was carried out in August. The source of this supply is the Kibwezi River, which runs through the estate. The water is pumped from the intake up to the factory, which is about nine miles away, and is carried for this distance in iron pipes laid along the surface of the ground and so exposed to the sun. As Masongaleni has a tropical climate the temperature of the pipes is high, but as the water is in constant circulation during the heat of the day, since it is in continual use in the factory processes, the effect of this heat on the water must be comparatively small. It will be noted that the water in the tanks at the factory itself, as seen in samples 137 and 138, is somewhat better than the river from which it is drawn. As, however, only one sample was obtained from each place, no definite deductions can be drawn from the results, except that as the sourse or the supply is open to contamination by human beings, it is a dangerous one, a conclusion borne out by the only bacteriological examination done. It was advised that some method of water purification should be carried out.

The results of the examination of the Nairobi water supply during 1921 in conjunction with those of previous years, can now be said to give sufficient figures to conclude that from the bacteriological point of view this supply is open to serious contamination at frequent intervals. The chemical analysis of the water over the same period does not show these periodical changes. The interpretation of these results is difficult. The following data are the only ones available from which to draw conclusions as the result of examinations made up to the present time :—

1. The reservoir at Kikuyu holds a three-day supply of water for Nairobi at the present rate of consumption, and has a capacity of about two million gallons.

2. The reservoir is fed by thirteen accessible springs of a comparatively small volume, and two inaccessible springs of comparatively large volume opening into the lower half of the reservoir.

3. There is a defective collecting drain around the reservoir to arrest surface water.

4. There seems to be a slight correlation between the rainfall and the B. coli count, but the rise in the latter figure does not take place till there has been continuous heavy rain for ten to fourteen days. The rainfall statistics are supplied by a non-European station-master at Kikuyu and are therefore open to question as to accuracy, so that this correlation cannot be stressed, especially as the examinations cover a period of time when the average rainfall has been considerably below the normal.

5. Examination of the accessible springs shows that on one occasion at least the water that they poured into the upper half of the reservoir is of passable purity.

6. On the one occasion on which it was possible to examine the water in the surface water collecting drain, its condition was not much worse than that of the water in the lower half of the reservoir.

7. There is a swamp on the other side of the hill to the reservoir which is 112 feet above the level of the water in the latter, and it is possible that this may connect with one or more of the springs by a fault in the strata.

8. The Nairobi water from the bacteriological point of view shows periodical and serious contamination, although the chemical examination reveals no change and so far no outbreak of water-borne infectious disease has been directly and unmistakably traced to the consumption of Nariobi water.

The contamination of the Nairobi water supply may occur in the reservoir, in the distributing tanks at Nairobi, or in the water mains. The result of several examinations made simultaneously at these various points shows, however, that the water as delivered in Nairobi does not differ appreciably from that in the lower half of the reservoir, and we must therefore conclude that the contamination occurs at Kikuyu.

Several possibilities present themselves to account for this.

Firstly, the contamination may arise from the access of surface water to the reservoir owing to the defects in the collecting drain. As in two places the hillside leading down to the reservoir has been cut away so as to allow water trickling down from the cut surface to collect in a pool at the base of the cliff, and as the water so obtained has been taken by a pipe from the pool across the surface water collecting drain directly into the upper half of the reservoir while no attempt has been made to prevent surface water gaining access to the pool, the real object of the drain surrounding the reservoir seems to be to persuade sightseers that the reservoir is adequately protected without interfering with the collection of as much water as the valley can possibly supply either by the springs arising in it or by the surface drainage from the hillside. As on that hillside there is a horse boma, whether used or not now I cannot say, and also a farm, this seems on the face of it the most probable source of contamination of the reservoir. Two difficulties stand in the way of accepting this explanation. In the first place the solitary examination of the surface water in the drain showed a count not much worse than that of the lower half of the reservior itself. If this is true of the surface water as a rule, one can only conclude that the various springs entering the reservoir are pouring in water almost as bad as that draining from the hillside, for otherwise the bacterial content of the surface water would be so diluted by pure water from the springs, that the count of the lower half of the reservoir would be considerably better than that of the water in the drain. In the second place if the access of surface water were the cause of the contamination, there should be greater correlation between the rainfall and the periods during which the water in Nairobi is impure, and one would expect that the time of greatest impurity would be immediately after heavy rain had washed down the accumulated filth of the dry season from the hillsides.

Secondly, the contamination may arise in the accessible springs supplying the upper half of the reservoir. This is again unlikely in view of the fact that the volume of these springs is comparatively small and the water they supply would therefore have to be very foul to contaminate the total flowing into the reservoir. Furthermore, on the occasions on which the water from these springs has been tested, the results show that the water is certainly no worse than that reaching Nairobi, and if anything, better.

Thirdly, the contamination of the reservoir may arise through the medium of the springs entering at the bottom of the lower half of the reservoir. This seems to be the most probable explanation of the facts given above, if we postulate that in normal times the water from the deep springs is adequately filtered by passage through a sufficient depth of soil, but that on occasions the water from these springs becomes very impure, probably as a result of a rise in the level of the ground water leading to a direct communication between the springs and a neighbouring body of water liable to contamination such as the swamp, by means of a fault in the strata.

Before the drawing of any conclusions is justified, the following investigations should be carried out:—

1. A geological survey to determine the existence of faults or cracks in the strata intervening between the reservoir and the swamp.
2. A test carried out during a period of contamination of the reservoir, to determine the possibility of water from the swamp reaching the reservoir.
3. Daily examination of the Nairobi water supply, the accessible springs at Kikuyu and the two halves of the reservoir over a period which includes part of the dry season and part of the wet season.

There can be no doubt that from the standpoint of the sanitarian the reservoir is inadequately protected from the access of surface water, and that a very considerable improvement in the quality of the water would be effected by covering over the lower half of the reservoir to exclude light and thus doing away with the growth of algæ, which prevents the present method of chlorination being effective from the bacteriological point of view. If this roofing of the lower half of the reservoir were carried out, the surrounding catchment drain made completely water-tight, the upper half of the reservoir excluded as a means of collecting and storing water, and those accessible springs which passed bacteriological tests over a sufficient period, piped from their exit direct to the lower half of the reservoir and adequately protected at their origin from the access of surface water, then bacteriological examination of the water would show fairly clearly whether the deep springs were subject to contamination or not, and if it were found that they were, then chlorisation of the water could be easily and effectively carried out at a much smaller cost than at present. The recommendation contained in the 1919 report that the fence around the enclosed area of the valley should be carried back to the crest of the hill still needs to be carried into effect, though if the reservoir is completely closed in, the necessity of doing this is not so great as under present conditions.

L.—THE HAEMORRHAGIC SEPTICAEMIA GROUP OF DISEASES.

An outbreak of pneumonic plague occurred early in the year, but it is impossible to report on the exact number of cases which showed the Bacillus pestis in the sputum, as this organism was confused with another gram-negative bipolar staining bacillus which closely resembled it in the first sputa sent to the Laboratory. The 42 slides seen and reported on as positive are therefore returned in Appendix 1 under the heading "Bacilli resembling B. pestis." Of these, 25 were undoubtedly cases due to this bacillus which resembles B. pestis, 7 were diagnosed before the recognition of this organism, and 10 were true B. pestis infection.

The confusion caused by the similarity of the two bacteria was increased by the onset of the disease closely simulating that of plague, in that there was sudden intense prostration, injection of the conjunctivæ, rapid weak pulse, cough with the expectoration of copious fluid sputum which was profusely blood stained. The temperature rose to 103 F. to 105 F. and some of the patients looked at the point of death. Slides of the sputa show innumerable gram-negative bipolar staining baccili. In the middle of a plague epidemic such cases justified a diagnosis of plague.

Had the subsequent course of the disease conformed to that usual in plague, no question as to the correctness of the diagnosis would have arisen, but in the majority of the cases the temperature fell rapidly, usually reaching normal on the third day, and the patient made a rapid and complete recovery (see charts No. 1-6). Too many cases followed this course to allow the diagnosis to go unchallenged, and the Laboratory had to confess that on closer examination the bacilli in the sputum of these cases differed slightly morphologically from typical B. pestis in that they were smaller, more delicate and with a less rounded appearance. About this time a fatal case occurred in an European which clinically resembled plague. This patient had been exposed to infection with B. pestis as he owned a go-down at Thika into which grain had been received from a store in Nairobi where rats were found dead of plague soon afterwards. Rats began to die in the Thika go-down and the patient became suddenly ill a week after he had cleared out his store and handled dead rats. Death took place within twenty-four hours of the commencement of the disease. A lung puncture before death yielded a pure culture of a gram negative bipolar staining bacillus, which fermented lactose, maltose, saccharose, dulcite, lævulose and galactose with the production of acid and gas, formed acid only in glucose, and had no action on mannite and arabinose. In milk it produced acid and clot. On salt agar no involution forms were seen and no stalactite growths took place in broth covered with a layer of oil. The growth on an agar slope 24 hours old, when emulsified in 2 c.c. of normal saline and injected intraperitoneally into a guinea-pig, was non-pathogenic. For these reasons the conclusion was drawn that the organism was not Bacillus pestis.

One other case occurred about this time. This was a man with gonorrhœa who developed a bubo. When this burst he sent a slide with a smear of the pus into the Laboratory. When examined this pus showed a heavy infection with the gram-negative bipolar straining bacillus described above.

Since this outbreak occurred at the commencement of the year no further cases have been seen. It is difficult to believe that a contaminative organism would have occurred only in these cases, all of which, except the one with the bubo, showed similar symptoms, and that its disappearance from smears of pus sent into the Laboratory should coincide with the cessation of these pseudo-plague cases. The matter needs further elucidation, and for the present we can only include the bacillus in the Pasteurella group of organisms. As it grew on bile salt neutral red agar containing mannite, galactose, glucose or lævulose, it cannot be placed in the animal sub-group of these organisms. Its non-pathogenicity to guinea-pigs excludes it from the plague sub-group, so that it would seem to form a special sub-group. Its importance lies in its liability to be mistaken for B. pestis in a smear.

An incident occurred during the campaign in East Africa on which the above observations throw some light. A draft of native troops was sent to Dar-es-Salaam from Nairobi, but on the voyage from Mombasa cases of illness occurred that from the examination of the sputum were diagnosed as pneumonic plague. The ship was duly quarantined at Dar-es-Salaam and further cases appeared among the contacts. The attention of the medical authorities was, however, drawn to the large percentage of recoveries, and Major Clemasha, I.M.S., who investigated the question, came to the conclusion that the disease was not true plague. A similar case occurred at the Carrier Hospital, Nairobi, at the same time as two fatal cases of septicæmic plague. The sputum of this case was swarming with gram-negative bipolar staining bacilli resembling very closely B. pestis. The man, however, recovered in a few days, and with our present knowledge, it is probable that this case should be classed as the same disease as that described above. Some time later plague was reported among some carriers at Dagoretti from the examination of a blood smear sent in to this Laboratory from one of the sick. Two of these carriers died from pneumonia but others with pneumonic symptoms, including the man whose blood showed so-called B. pestis, recovered in a very short time. Presumably there were also examples of this pseudo-plague disease, as no other cases of plague were reported from this district at this time, and no mortality was seen amongst the rat population.

M.—DIFFERENTIAL LEUCOCYTE COUNTS.

In Appendix VI will be found a table showing the results of differential leucocyte counts carried out during the year. The difference in the total shown in Appendix I under this head, and the total of cases in Appendix VI is represented by blood slides sent in for a differential count, which were found on the conclusion of the count to contain too few leucocytes to justify a numerical report.

Inasmuch as the blood slides recorded in the table were sent in from cases of pyrexia, and no history or list of symptoms accompanied them, it is impossible to judge the significance of the counts at this date, especially as no record of the eventual diagnosis has been kept. It is interesting to note that polychromes appeared as often in cases with as in those without a relative increase of large mononuclear leucocytes. This, together with the frequency of an increase in the large mononuclear leucocytes shown in pyrexias during 1921, when malaria was notably less common than in previous years, tends to throw doubt on the value of such an increase as evidence of malaria, although in one case showing gametocytes of subtertian malaria, the large mononuclear leucocytes did indeed rise to 43 per cent. of the total white blood corpuscles.

It is also worthy of note that a European child with a rectal infection of S. mansoni, gave a count of eosinophile leucocytes of 10 per cent. of the total white blood corpuscles. Several slides gave an increased polymorphonuclear leucocyte count. Most of these were cases of pneumonia or various septic diseases.

During the coming year it is hoped to obtain more facts about cases from which slides are sent in for differential counts, so that in our next report it may be possible to present data of some value in making such counts an aid to diagnosis.

N.—FRAMBŒSIA OR YAWS.

From the Laboratory point of view, little can be written on this subject, as the investigations carried out are limited almost entirely to a visit of one of the Assistant Bacteriologists (Dr. Allen) to Kisii, where he was enabled to see cases as they came in from the Reserves to hospital for treatment. This visit was made towards the close of the year, so that as most of the time in Kisii was spent in obtaining material to bring back to the Laboratory for more leisurely examination, the actual investigations were not concluded before the year ended, and so much must be left for next year's report.

A detailed examination was made of 33 cases, of which 31 were diagnosed as yaws. Only four cases were seen which could be described as tertiary yaws, and one of these left the hospital before any examination could be carried out. Each patient was closely questioned and as accurate a history of the illness obtained as was possible. A blood slide was then taken, and also blood withdrawn for a Wassermann test. (This was allowed to clot, and after standing the exuded serum was drawn up into a sterile glass capsule.) Lesions which appeared typical were then selected in each case, and after careful removal of the crust, and cleansing of the ulcerated surface with absolute alcohol, the serum exuded by pressure on the base of the lesion, was spread on glass slides. In four cases smears were also made from the crust on the lesion, a scraping from the granulating surface, and from serum drawn up by capillary attraction into a fine capillary tube passed through sterilised sound skin into the base of the lesion. It may be stated here that S. pertenue was not found either in the crust on the lesion or in the base thereof in any case. An attempt was made to examine the serum by dark ground illumination at Kisii, but the source of light was not sufficiently powerful to enable this method of diagnosis to be carried out satisfactorily. A simple smear of the serum was made in each case, and in some cases smears were made by the Indian Ink method.

In four cases lesions were excised, and placed in a suitable fixative for examination at a later date in Nairobi.

Dr. Allen carried out differential leucocyte counts on all blood slides made, and also examined the smears of serum from the lesions. Smears made by the Indian Ink method were examined immediately, while the simple smears were stained by a modification of Fontana's method, as follows :—

1. Fix for five minutes in—

Acetic Acid B.P.	1 c.c.
Formalin (40 per cent. formaldehyde ...	20 c.c.
Distilled water	100 c.c.

2. Wash with water.
3. Wash with absolute alcohol.
4. Flame off the absolute alcohol.
5. Pour on a solution consisting of—

Tannic Acid	5 gms.
Carbolic Acid 1 per cent. solution in distilled water	100 c.c.

and heat gently for half a minute.

6. Wash the film with distilled water.
7. Pour on a solution consisting of 0·25 per cent. solution of silver nitrate to which a solution of ammonium hydrate has been added till the precipitate which first forms is almost but not quite redissolved.
8. Wash in distilled water, dry and examine.

On the whole the Indian Ink method gave unsatisfactory results and with it there was always some difficulty in diagnosing the various spironema. The modified Fontana method gave a positive result in 20 cases out of 28 in which it was used, and in only one case was the smear negative by the Fontana method and positive by the Indian Ink method. The latter gave positive results in 13 out of 30 cases in which it was employed, and in 12 cases it gave a negative result when the Fontana stain gave a positive one. On these results it would seem that the Fontana method was the more reliable, but too much stress cannot be laid on this as further smears were not taken when one method showed that S. pertenue was present.

Thirty-one sera were brought down to Nairobi from these patients and a Wassermann test performed on them. All the sera but one arrived in an uncontaminated condition. The results of the tests as given by the fourth method of the Medical Research Committee were as follows :—

Of 30 sera examined, 24 or 80 per cent. gave a + + reaction.
,, ,, 4 ,, 13·3 ,, ,, +± ,,
,, ,, 1 ,, 3·3 ,, ,, + ,,
,, ,, 1 ,, 3·3 ,, gave a negative reaction.

The lesions which were excised and brought to Nairobi for histological examination have not yet been investigated. The results of such examination will appear in next year's Annual Report.

A synopsis of the cases showing the history, site of lesion, presence or absence of spirochætæ, Wassermann reaction, and differential leucocyte count will be found in Appendix VII, to which reference should be made for further information. The number of cases examined is too small to justify any conclusions being drawn from the differential blood counts. It will be noted, however, how rarely the primary lesion is situated on the genital organs, and that young children exhibit primary yaws as well as adults.

Photographs of several of the cases will be found attached.

APPENDIX I.

	Human.																			Cat.	Dog.		Guinea Pig.	Horse.		Rat.	Ox.			Various.		
	Blood.	Cerebro-spinal Fluid.	Exudate from Bulla.	Exudate from Liver	Exudate from Lung	Exudate from Lymphatic Gland.	Exudate from Spleen.	Fæces.	Gastric Contents.	Hair.	Nasal Secretion.	Pharyngeal Secretion.	Pus.	Skin.	Sputum.	Ulcers (Secretion).	Urethral, Vaginal & Prostatic Secretion.	Urine.	Various Tissues.	Spleen Exudate.	Blood.	Skin.	Spleen Exudate.	Blood.	Skin.	Spleen Exudate.	Blood.	Exudate from Lymphatic Gland.	Spleen Exudate.	Water Supplies.	Milk.	Shaving Brushes.
Total Specimens Submitted	1612	24	1	6	98	85	121	307	2	2	6	10	39	1	638	17	264	125	25	2	190	3	1	2	2	3873	7	3	8	25	3	2
Enumeration of Erythrocytes and Leucocytes	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Differential Leucocyte Counts	113	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spleno-medullary Leucocythæmia	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Parasites Detected by Morphology or Staining Reactions.																																
Plasmodium vivax	19	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plasmodium falciparum ...	83	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plasmodium malariæ	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plasmodium vivax and falciparum (crescents)	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Plasmodium falciparum with crescents	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spirillum rossi	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Babesia canis	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	86	...	...	...	...	...	...	...	...	...	...	...
Piroplasma bigeminum ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...
Theileria parva	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...
Leishmann-Donovan Bodies ...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Spirochætæ	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Treponema pallidum	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Treponema pertenue	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Entamœba coli cysts	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Trichomonas intestinalis ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Monilia	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Microsporon	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Sarcoptes	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...
Bacillus anthracis	1	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...
Bacillus lepræ	...	...	1	...	...	...	...	...	...	...	2	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus pestis	...	...	...	...	22	34	37	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	48	...	...	...	...	...	...
Bacillus resembling B. pestis...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	41	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus tuberculosis	...	...	...	...	1	...	...	...	...	...	...	...	...	...	37	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Gonococcus	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	49	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Meningococcus...	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pneumococcus	...	4	...	...	...	...	1	...	...	...	...	2	1	...	56	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Staphylococcus	...	...	...	...	...	1	...	...	...	...	...	...	6	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Streptococcus	...	...	...	...	...	...	...	...	...	...	...	2	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Ancylostomidæ	...	...	...	...	...	...	...	33	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Ascaris lumbricoides ...	...	...	...	...	...	...	...	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Schistosoma hæmatobium	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Schistosoma mansoni ...	...	...	...	...	...	...	...	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Tænia saginata	...	...	...	...	...	...	...	30	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova Trichiuris trichiura ...	...	...	...	...	...	...	...	26	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova double infections... ...	...	...	...	...	...	...	...	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova triple infections	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ova quadruple infections ...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Larvæ Strongyloides stercoralis	...	...	...	...	...	...	...	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negative	832	13	...	5	86	47	83	190	...	1	4	5	19	1	488	14	215	...	...	2	104	2	...	2	2	3825	4	3	4	...	...	...
Agglutination Tests.																																
Bacillus typhosus	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus paratyphosus A. ...	11	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus paratyphosus B. ...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus paratyphosus C. ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus proteus X19	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Micrococcus melitensis ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negative	185	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cultural Examinations.																																
Bacillus coli	...	...	...	...	...	...	...	28	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus pestis	...	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...
Bacillus resembling B. pestis...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bacillus typhosus	...	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Pneumococcus	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Staphylococcus	...	...	...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Streptococcus	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Monilia	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negative	20	...	...	...	...	...	...	22	...	...	...	...	4	1	...	...	4	4	...	...	...	...	...	...	...	...	...	...	...	...	...	2
General Chemical and Microscopical Examination ...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	...	...	...	118	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Complete Bacteriological Examination	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	3	...
Wassermann Reactions :—																																
Positive result	196	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Negative result	121	1	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Histological Examination ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	25	...	...	...	...	...	...	...	...	...	...	...	...	...

Total Examinations made ... ... 7,502.

Stock Vaccines Issued.	
Desiccated calf lymph ...	17,300 doses.
Glycerinated calf lymph ...	65,971 ,,
T.A.B. vaccine	800 ,,

Autogenous Vaccines Prepared	54
Of Bacillus coli	27
Of Staphylococcus	19
Of Streptococcus	1
Of Micrococcus catarrhalis and Staphylococcus	1
For acne	2
For asthma	1
For pyorrhoea	3

APPENDIX II.

VACCINATION, 1921.

Compiled from figures supplied by the Chief Sanitation Officer and from Laboratory Returns.

Stations.	Doses issued.	Vaccinations.			
		Total.	Successful.	Unsuccessful.	Results Unknown.
Eldama Ravine	950	563	7	—	556
Eldoret	30	23	18	—	5
Embu	725	1,415	93	48	1,274
Fort-Hall	1,400	1,323	—	—	1,323
Kabarnet	600	204	186	12	6
Kacheliba	100	?	?	?	?
Kakamega	5,200	1,542	28	2	1,512
Kericho	12,900	11,666	126	107	11,433
Kikuyu Mission	151	?	?	?	?
Kisii	500	690	68	13	609
Kismayu	200	486	81	87	318
Kisumu	25,600	24,707	22	—	24,685
Kitui	150	90	50	12	28
Kyambu	320	175	31	8	136
Lamu	10,600	7,557	3,863	2,106	1,588
Machakos	1,600	15	—	—	15
Magadi	95	17	15	—	2
Malindi	200	17	—	—	17
Meru	200	268	194	48	26
Mombasa	13,270	4,530	1,784	154	1,592
Mombasa Prison	—	950	508	349	93
Nairobi (M.O.H.)	1,163	1,122	103	230	789
Nairobi (Police)	1,000	235	94	59	82
Nairobi (Prison)	—	640	124	150	366
Naivasha	185	75	20	43	12
Nakuru	198	121	—	—	121
Nandi	160	21	—	—	21
Narok	200	124	63	54	7
Nyeri	100	—	—	—	—
Rumuruti	200	?	?	?	?
Samburi	800	302	81	198	23
Turkhana	800	?	?	?	?
Voi	45	31	6	20	5
Wazir	800	?	?	?	?
Total	80,442	58,909	7,565	3,700	47,644

APPENDIX III.

FURTHER NOTES ON A TYPHUS-LIKE DISEASE OCCURRING IN THE HIGHLANDS OF KENYA COLONY.

A description of four cases of suspected typhus will be found in the appendix to the Annual Medical Report for this Colony for 1920 written by Dr. Gilks, the Principal Medical Officer. The present notes bring the knowledge of the disease in Kenya up-to-date, although it must be acknowledged that beyond adding to the list of cases, very little has been done to elucidate the epidemiology, or determine the true nature of the infection. All the cases described in the first and in this paper occurred in the Highlands of Kenya. No cases have been reported from the Tropical Coast zone or from the hot Lake area.

Cases 1 to 9 were treated in Nairobi, and cases 10 to 12 in Nakuru. The four cases described in the first paper are referred to when necessary in this note under the numbers then given to them. The clinical notes of cases 5 to 9 were supplied by Dr. Welch, Resident Surgical Officer, Nairobi, and of cases 10 to 12 by Dr. Wilson, Senior Medical Officer, Nakuru.

CASE No. 5.

European Male Adult. Chart No. 7.

History.—Taken ill on the 4th April, 1921, with intense headache and pyrexia.

On examination 9.4.21.—There is a general discrete papular rash on the face, abdomen, arms, legs, palms of the hands and soles of the feet.

Tongue.—Very foul.

Chest.—Nil.

Abdomen.—Spleen enlarged.

Urine.—Phosphates.

Lymphatic glands enlarged on both sides of the neck.

On the back of the neck is a clean cut ulcer which the patient ascribes to the bite of an insect while riding in a rickshaw ten days before the onset of the headache.

11.4.21. Rash much more marked.

16.4.21. Temperature normal.

The rash persisted seven days after the fall of the temperature to normal.

Patient's serum agglutinated B. proteus X.19 on the 12th day of illness in a dilution of 1 in 128.

CASE No. 6.

Female European Adult. (Chart No. 8.)

History.—12.5.21.—Complains of having suffered from pyrexia, headache and pain localised in the right mastoid region.

On examination 16.5.21.—A faint generalized papular rash.

Enlarged glands on both sides of the neck.

Tongue.—Dry and dirty.

Spleen.—Palpable.

Agglutination.—Negative to B. proteus X.19.

17.5.21. Rash very pronounced and generalized. There are several spots on the palms of the hands and soles of the feet. Headache, backache and joint pains very severe.

27.5.21. Temperature normal. Agglutination to B. proteus X.19 is present in a dilution of 1 in 60 of the patient's serum.

The rash persisted eight days after the temperature fell to normal.

CASE No. 7.

European Male. Age 35. (Chart No. 9.)

History.—Onset sudden on the 13th July, 1921, with headache and rigor. The headache was intense and accompanied by photophobia.

A rash appeared on the 18th July commencing on the arms and abdomen.

On examination 23.7.21 complains of a severe headache.

Temperature.—104° F. Pulse 100.

Abdomen.—Spleen palpable.

Chest.—Nil.

Urine.—Nil.

Tongue.—Foul and dirty.

Rash.—A papular rash all over the body most marked on the arms and legs, involving the palms of the hands and the soles of the feet.

29.7.21. Temperature normal. Agglutination to B. proteus X.19 is present in a dilution of 1 in 160 of the patient's serum.

The rash persisted until the 2nd August.

The patient made an uninterrupted recovery.

CASE No. 8.

European Female. Age 47. (Chart No. 10.)

History.—13.8.21. Complains of having been taken ill eight days previously with headache, and pains in the back and joints.

Two days ago a rash appeared.

On examination there was a generalized papular rash involving the palms of the hands and the soles of the feet.

Tongue.—Very foul and dirty.

Chest.—Nil.

Abdomen.—Spleen enlarged one finger's breadth below the costal margin.

Urine.—Trace of albumin.

17.8.21. Agglutination present with the patient's serum in a dilution of 1 in 180 with B. proteus X.19.

18.8.21. Defervescence.

22.8.21. Rash faded.

The patient made an uninterrupted recovery.

The following case occurred in a private house.

There is unfortunately no temperature chart available.

CASE No. 9.

European Female. Adult.

History.—Illness commenced with a sore throat and acute pains all over the body, somewhat resembling influenza. Temperature was 101° F. and varied between 100° and 101° for four days.

Fifth day.—Temperature 102°. There was a discrete papular red rash on the extensor surface of both forearms. Slight rash on the face. The conjunctivæ showed marked injection. Headache very marked.

Sixth day.—Rash generalized, involving the palms of the hands and soles of the feet. There were no enlarged glands and no history of a bite.

Spleen.—Negative.

Urine.—Negative.

Temperature fell to normal on the 11th day. The rash was still visible three days later.

Tenth day.—Blood negative to Weil Felix reaction.

Three weeks later the patient was still very weak and debilitated.

The following three cases occurred at Nakuru:—

CASE No. 10.

Male. Age 28. (No chart available.)

History.—Taken ill about 2.8.20.

First seen 6.8.20. Very ill. Temperature 103° F. Sleepless.

Furred tongue. Pains in joints marked.

Rash just appearing, well marked on arms and leg and of a purplish colour—some spots petechial. A supurating yellow ulcer on leg, to which he ascribed illness, suggesting it was a tick bite. A patch of broncho-pneumonia present in lung and profuse expectoration.

10.8.20. Patient having continued very ill with temperature 103° F. was now in a "typhoid" state.

Rash fading.

14.8.20. Patient already getting better.

CASE No. 11.

European Male Adult. (Chart No. 11.)

History.—Admitted 8.1.21 as a doubtful enteric. Stated had been badly bitten by unknown insect in Nairobi about 10 days previously. No bites seen.

9.1.21. "Sore" all over. Sleepless. Headache. Rash commencing.

10.1.21. Headache. Sore throat. Cough. "Rash more profuse."

11.1.21. Headache very severe. Sleepless.

12.1.21. Rash on hands.

13.1.21. Drowsy—later restless. Rash fading on abdomen.

14.1.21. Severe headache. Throat painful.

15.1.21. Headache still severe, and throat very painful. Rash disappearing on body but still on arms, legs and buttocks.

16.1.21. Better.

17.1.21. Better but still headache.

18.1.21. Much better. Blood examination for enteric (result negative).

CASE No. 12.

European Male. Aged 26. (Chart No. 12.)

History.—First felt ill 8.2.21. Carried on work till 11.2.21.

First seen 12.2.21. Rash all over body and extremities, including palms of the hands and soles of the feet. Confused in mind. Temperature about 103° F. Severe headache. "Typhus" diagnosed at sight. Admitted to hospital on the same day.

13.2.21. Very restless and delirious. Later drowsy, severe headache. Pain all over body.

14.2.21. Rash still coming out. Headache and sore throat present. Alternately delirious and drowsy, but not sleeping.

15.2.21. Rash still coming out. Feeling better and beginning to sleep.

16.2.21. Again very delirious. Restless.

17.2.21. Rash still coming out on back and abdomen. Incontinence of urine and fæces with muttering delirium. Joints very painful.

18.2.21. Quieter. Rash still marked. Vertigo and headache present. Later stupor—pain in legs—rash fainter.

19.2.21. Rash fading. Tongue beginning to clear. Still delirious.

20.2.21. Patient rational and comfortable.

LABORATORY WORK.

As stated above, the B. proteus X.19 was received in time to do an agglutination test on case No. 3. Thereafter the Weil Felix reaction was carried out on all cases of the disease.

The reactions were carried out by the method described by Garrow in the *Journal of the Royal Army Medical Corps*, Vol. 28, 1917. Emulsions were obtained by growing the organism on glucose agar in a Roux flask and washing off the resulting growth in 24 hours with a 0·5 per cent. solution of formalin in normal saline. The resulting emulsion was centrifuged in a high speed centrifuge and the supernatant fluid pipetted off. This was repeated several times until a uniform white emulsion was obtained. The emulsion was standardized by the opacity method described by Broughton Alcock in the *Journal of the Royal Army Medical Corps*, 1918, Vol. 30. All agglutinations were controlled by a saline control and by a high titre positive serum.

The agglutination results are given in the case histories. One case gave no agglutination at all, and two of the cases gave a low titre, case No. 3, for example, only gave a titre of 1 in 40. This case, however, was the first one in which the agglutination was performed, and in making the emulsion for it, the B. proteus was grown in ordinary agar, and not glucose agar, and this may have affected the titre of the agglutination. Still, it will be seen that the titre rose from negative on the fifth day to 1 in 40 on the tenth day.

These titres may appear too low to be taken as positive confirmation of the diagnosis of typhus fever, but it is difficult to discover what titre should be accepted. Some observers say that a dilution of less than 1 in 200 should not be taken, others demand one of 1 in 100, and others again one of 1 in 50.

Dr. Pirie, Superintendent, Routine Division, South African Institute for Medical Research, informs me that:—

> "Our experience of the reaction as diagnostic has been disappointing. No case so far, even when tested about the twelfth day or during early convalescence, and from cases which clinically were severe Typhus, has given a reaction in dilutions of greater than 1 in 500, many have only reacted in dilutions of about 1 in 10 to 1 in 40, and others have given no reaction at all."

It is probable that this low titre is on a parallel with our experience in agglutination reactions in cases of the Enterica and Dysentery. In the Enterica as has been noted formerly in the Nairobi Laboratory Annual Reports, it is not uncommon to fail to get agglutination at all or to get in only in late convalescence. (A note on such a case is given in the Nairobi Laboratory Annual Report, 1919.) Also the agglutination given with Flexner's bacillus is uniformly low in Kenya compared with elsewhere.

In order to determine if agglutinins for B. proteus X.19 are present normally in the blood of local residents, the Weil Felix reaction was performed on sera obtained from 93 patients in the Native Civil Hospital, Nairobi, selected at random from the medical and surgical wards. Out of these, four gave an agglutination of 1 in 10 to B. proteus X.19, and one a titre of 1 in 10 to B. typhosus and B. paratyphosus A., B. and C., and of 1 in 40 to B. proteus X.19. It has therefore tentatively been decided to accept a titre of 1 in 50 as useful corroborative evidence. Case No. 9 gave no agglutinuation whatever, not even with a serum dilution of 1 in 10 on the tenth day of illness. This was unfortunate, as from that case three guinea pigs were inoculated for immunity experiments. But still according to most observers, a small proportion of cases may not agglutinate B. proteus X.19 even in known Typhus. The guinea pigs were inoculated intraperitoneally each with 3 c.c. of freshly drawn venous blood. From the temperature charts attached (charts 13-16), it will be seen that all these pigs ran a very similar temperature curve, markedly different from that of the control animal. No attempt has been made to carry on the virus as we have not a large enough supply of guinea pigs for the work, but it is hoped to bring the four animals to England for further immunity investigations.

The clinical appearance of the disease is that of a mild Typhus, such as described by Brill, and the agglutination results support this idea. It is difficult, however, to trace out the source of the infection. Typhus is a louse-borne disease. Nuttall, in an article "Lice and Disease" (Parasitology, Vol. 10, p. 56), states that lice are the only known vectors of Typhus. Yet all the cases in which the disease has been observed in Kenya have been Europeans of the well-to-do class. None of the patients had vermin, and all were of cleanly habits and so unlikely to harbour them. Granted that a European may pick up a stray louse in a rickshaw, railway carriage, or in his office, the chances of that louse being an infected one are very small, for a patient suffering from Typhus only carries the virus in his blood during the pyrexial period, and the life of a louse is at most 30 days. In the literature available I cannot find that any conclusion has been reached as to the length of time a louse can carry the infection, but if it is assumed that it may carry the infection during the remainder of its life, the duration of infectivity is not likely to be on the average much more than 14 days.

It is not impossible that Europeans may pick up an occasional infected louse, but it must be a very rare event, unless there is a large reservoir of infection. The unlikelihood of its happening would account for the particularly scattered distribution of the cases. Up to the present we have never seen more than one case in the same house or family, nor is the incidence confined to any one quarter of the European area.

Even granting the possibility of an European picking up an infected louse, the source of the infection of the louse is still obscure. It may be postulated that typhus is an endemic disease among the local natives, and the latter have acquired such resistance that they only suffer from the disease in a mild form unrecognizable as typhus. An ambulant variety such as this could transmit the virus to a non-resistant individual, who would then probably develop the disease in a more typical form.

That typhus does exist in an attenuated form has frequently been recorded. Hall (Typhus Fever—Military Surgeon, 1916, Vol. 39, No. 5) states that in children the rash in the milder cases is generally transitory, while a prominent symptom may mask the true nature of the case. Brohn (Munch. Med. Woch., 1918, Sept. 3rd) states that typhus in children may be unaccompanied by a rash. Martini (Deut. Med. Woch., Feb. 7th, 1918) points out the great danger to the adult community of mild cases occurring in children and of the possibility of the transmissions of the disease by unrecognised cases. Potel (Arch. Med. et Pham. Nav., June and July, 1917) states that among the Serbians the disease usually showed marked benignity—without exanthem or rash—and its existence was unsuspected until cases began to appear among French hospital orderlies.

Instances are also on record of outbreaks of typhus where no communication with any previous case or source of infection could be traced. Stack, in the *British Medical Journal*, 9th February, 1918, records one such outbreak, and Kantor (*Journal of Infectious Diseases*, Vol. 17, 1918) describes three cases of typhus among immigrants which must have been contracted on board ship, although no know case occurred during the voyage.

But there is still a serious flaw in this supposition. The European is not the only non-resistant individual in the Highlands of Kenya. It is a well known fact that typhus is a disease of temperate climates and is not endemic in tropical regions. Now in Nairobi there is a very mixed population drawn from all parts of the Protectorate. There are Kavirondo and Baganda from the hot Lake area, Swahili from the tropical Coast zone, Somali from the Desert zone and Indians from the hot and steamy parts of India. These in number would almost equal the total number of local natives, and are presumably non-resistant to typhus, yet in spite of careful observation, not a single case of typhus or a disease resembling it, has been seen amongst them. This is the most weighty argument against the cases herein described being typhus. All the other non-resistant peoples who come into much more intimate contact with the local native than the European, would appear to escape infection, a very extraordinary fact if the disease is typhus carried from an immune local tribe.

Another possibility is that the disease is one resembling Spotted Fever of the Rocky Mountains, in that it has an animal host and not a human one, the vector being a tick. It is interesting to note that a similar theory has been suggested by Lt.-Col. Megaw in the *Indian Medical Gazette*, October, 1921, in an article on a Typhus-like Fever in some small hill stations at an altitude of 4,500 feet.

No work has been done here on the latter theory yet, nor is it proposed to do any until the present investigation is completed. When that is done, it should be possible to state with a fair degree of certainty whether these cases were typhus or not. It is to be regretted that our laboraory work cannot be completed in time to appear in these notes, and that in consequence it is not possible to draw any definite conclusions from our present knowledge. This must be left for a future report.

APPENDIX IV.

A PRELIMINARY NOTE ON THE USE OF AN AUTOGENOUS COLI-TYPHOID VACCINE IN THE TREATMENT OF DISEASES DUE TO INTESTINAL TOXÆMIA AND PARTICULARLY RHEUMATOID ARTHRITIS.

Experience with the vaccine reported on in this paper dated from August, 1919, but owing to fourteen months' absence from the Colony on leave, and the large amount of administrative and routine work which has to be carried on by an inadequate staff in addition to research work, nothing more than a summary of results obtained in this country and details of the preparation of the vaccine can be given in this preliminary note. The publication of these details has been thought advisable in view of the encouraging results obtained here and in the hope that other workers will give the method a trial. Full details of the cases with a description of the baccilli concerned will be given in a later paper.

The original patient was case 237, an account of whose lesions is given below. He was sent to the Laboratory by Dr. Gilks, Principal Medical Officer of the Colony, but at that time Resident Surgical Officer at the European Hospital, Nairobi, with a view to determining whether any vaccine treatment was possible or advisable. The usual sites of septic absorption was examined and eliminated one by one until they were narrowed down to the bowel. It was then that the idea of isolating a number of organisms from the fæces and testing their agglutinability by the patient's serum suggested itself to me. A number of lactose fermenters were isolated on MacConkey's lactose bile-salt neutral red agar and sub-cultured on to agar slopes. The purity of these cultures was then tested, and when this was assured, their agglutination reactions with the patient's serum were tested. One organism agglutinated markedly and from it the vaccine was prepared. The initial dose was made very small, namely under one million bacilli to the dose. Succeeding doses were put up so that each was twice as strong as its immediate predecessor. The vaccine was administered at weekly intervals. No reaction was observed with the first few doses, but as the strength of the injection gradually increased, more and more reaction was seen and distinct improvement in the direction of lessened pain, increased freedom of movement and cessation of the progressive character of the disease, followed. The results eventually obtained were so striking that application for similar vaccines began to come in from medical practitioners and from the lay public. The demands became so great at one time that the depleted staff of the Laboratory was unable to cope with them. This in itself is not without weight as a testimony to the effect of the vaccine, although of no value as scientific proof. The original case 237 has now been under observation for a period of 2½ years, and the improvement has persisted up to the present.

The method used in the preparation of the vaccine has been modified as more and more cases have come up for treatment. We do not pretend that the best method has even yet been attained, and it is possible that as good results may be obtained with a simplified technique. The one used at present is as follows:—

A small platinum-loopful of a recently passed stool of the patient is inoculated into each of two tubes containing bile-salt peptone water (sodium taurocholate 0·5 per cent., peptone, 1 per cent.). The tubes are incubated at 37° C. for 24 hours, and then a loopful from each is spread over the surface of MacConkey's neutral red bile-salt lactose peptone agar in Petri dishes which must be in sufficient number to ensure isolated colonies on the last plates seeded (four plates to each loopful usually suffice). These plates are incubated at 37° C. for 24 hours, and then colonies are picked off into tubes of nutrient broth, and after incubation the various cultures are tested for agglutination against the patient's serum. Three methods have been employed in testing this. The original one was that described by Broughton-Alcock.(1) This did not prove very satisfactory in practice, possibly owing to the delay experienced in the reaction with bacilli of the coli group. The microscopic method was then adopted. A serum dilution of 1 in 30 is used with the culture under examination and a control with saline is put up at the same time. Agglutination is usually found to take place within half an hour, in cases which prove to be positive, and any agglutination after an hour has elapsed is reckoned as negative. This method has proved most useful in practice in this Laboratory, as the senior Indian assistant has had many years of practice in it in testing for typhoid agglutination, and with our small staff it has been found necessary to delegate as much as possible of the less skilled portion of the method to the subordinate staff. All reactions are checked and read by one of the medical officers. The third method of testing agglutination is that of

Dreyer, modified firstly by the use of Donald's drop pipettes, secondly by using a serum dilution of 1 in 50, and thirdly by incubating the tubes containing the serum dilutions and cultures in a water bath at 50° C. for four hours. Unless these modifications are used the results do not agree with those obtained by the microscopic method. This has been also pointed out by Dudgeon, Wordley and Bawtree.(2) Those cultures which show agglutination are again plated out on MacConkey agar in Petri dishes and incubated for 24 hours at 37° C. At the end of this time isolated colonies are picked out and inoculated into nutrient broth, and after a further incubation these cultures are again tested as to their agglutinability with the patient's serum. If there is any doubt as to the purity of the cultures which show agglutination now, the process of plating out on MacConkey agar is repeated. The cultures which are finally passed as pure, and as agglutinating with the patient's serum, are subcultured on to agar slopes. The resulting growths are washed off with 0·5 per cent. solution of carbolic acid in normal saline (freshly made up at the time of use), and the emulsion so obtained shaken in a vaccine shaker in a sterile bottle containing glass beads for an hour or more until the bacteria are uniformly distributed throughout the liquid. The emulsion is then allowed to stand for 48 hours, when a loopful is subcultured on to an agar slope. As soon as the vaccine is sterile by this test, it is standarised by the method described by Brown(3) to contain 0·01 mgm. of the dried bacilli in the first dose. Succeeding doses are now made to increase in strength according to the condition of the disease in the patient. As a rule the early doses can be made so that each is twice as strong as the preceding one. The later doses should increase in strength less rapidly. The vaccine is administered at intervals which vary with the reaction experienced by the patient, a period of three clear days after all reaction from the previous dose being usually sufficient.

It is impossible to discuss adequately in the present paper the pathological conditions in which the vaccine has proved of value. It would seem that there is a certain group of diseases attributable to the absorption of toxins or even of bacilli from the gut. Chief amongst those which have come under our notice for vaccine treatment are diseased conditions of joints which are grouped under the somewhat comprehensive term of rheumatoid arthritis. Clinically many of the joint cases treated by us conform to one or other of the types of rheumatoid arthritis as described in the text-books. Some were diagnosed by specialists in England as such. It is suggestive that every one of these cases showed bacilli of the coli-typhoid group which agglutinated with the patient's serum. Of course it is open for anyone to object that normal people may agglutinate such bacilli, but so far no normal person examined by us has shown such organism, and two cases of gonorrhœal arthritis gave no serum reaction with any of the bacilli isolated by us. Dudgeon, Wordley & Bawtree(4) in their paper state that out of 66 normal individuals examined for agglutinins for B. coli, only five showed any. One cannot however, attribute all cases of rheumatoid arthritis to absorption of toxins or bacilli from the gut as several cases showing this condition clinically, gave no agglutination with any bacilli isolated from the fæces. On our results it may be claimed, however, that in such cases should one be able to isolate from the fæces bacilli which agglutinate with the patient's serum, a vaccine prepared from these bacilli will usually bring about considerable improvement or even cure, if the disorganisation of the joints has not proceeded to such a degree as to prohibit the complete return to normal.

In addition to these arthritis cases which so far have formed the bulk of our patients, a few persons have been treated provisionally with an autogenous vaccine prepared as described above for diseased conditions which have to our mind showed some probability of intestinal autointoxication as the basic lesion. Most of these have asked for relief for indeterminate aches and pains or even for mere malaise. Close questioning has usually revealed some development of one or more joints in a very early stage of the disease. One case treated showed no joint lesions at all but complained of chronic indigestion. Investigation revealed symptoms which might be attributed to intestinal toxæmia and an autogenous vaccine has given much relief after only two or three doses, but it is too early to count this as a cure. One case suffered from periodic sciatica with great disability even between attacks. She had suffered from dysentery some little time before the commencement of the disease, and there was a definite colitis present. A vaccine was prepared and considerable relief followed the first two doses. The patient then left for Europe taking the vaccine with her, and up to the present no further reports have been received.

The work of identifying the bacilli isolated in the various cases treated up to the present is still in progress. A number have been put through the sugars, but at the time of writing it is impossible to say more than that the majority of the bacilli are lactose fermenters and that, though many of them have very similar action on the various sugars, yet they are not identical, and even in the same case two or more organisms differing in fermentative capacity may be isolated. It may be that as the serum relationships are further investigated we shall find that all the bacilli belong to one or two serum types only. This point is being determined at the present moment as well as the equally important question of the pathological action of these same bacilli on joints.

One point that may be noticed is that in one case at present under treatment, and so not recorded here, the patient suffered from periodic febrile attacks every few days and during these attacks passed bacilli in the urine identical with those isolated from the stool and agglutinated by the patient's serum.

Appended are short clinical notes on the various cases treated up to date as far as these are available, dates in brackets being those of vaccine treatment.

Case 237.—Male (August, 1919).—Rheumatism began in 1913 in the shoulders, wrists and ankles. Was treated with salicylates, potassium iodide, liniment and radiant heat. Slight local improvement resulted but the general condition remained unchanged. Developed endocarditis at the end of 1913. In bed for 3 months and off duty for 6 months. Was advised to come to East Africa in 1917, when he had considerable pain but little fixation of the joints. The pain became worse and the joints, especially the left shoulder and right wrist, became more or less fixed. In 1918 he first came under observation by Dr. Gilks. The left shoulder joint showed much limitation of movement, and marked creaking was observable on attempting to move it. The shoulder muscles were very wasted. The right wrist was swollen, the swelling involving the carpal joints as well, while there was considerable bony deformity and a great thickening of the periarticular fibrous tissue. Movement was practically absent. The phalangeal joints of the fingers showed spindle-shaped swelling with much restriction of movement, though bony deformity was absent. Other joints were affected less markedly though in most there was considerable pain. Vaccine treatment was commenced in August, 1919. Twenty doses were given at weekly intervals, the first ten ranging in strength from 1 to 512 million bacilli and the second ten from 128 to 1,024 million. The patient is at present having a third series of injections in doses ranging from 14 to 2,000 million bacilli as an insurance against a recurrence. His general health has greatly improved. He is fatter, has a good appetite, is not depressed mentally, and the muscles have recovered a good deal of their tone. The movement of the left shoulder has increased so that he can touch his right ear over the top of his head. The movement of the right wrist has not improved. The finger joints are now normal in shape and movement. There is no pain in any of the joints of the body. The patient can now play tennis and ride a motor cycle, both of which amusements were formerly impossible.

Case 321.—Female. (April, 1920).—Complained of pain and disability in the left knee. Rheumatic pain in it for years. Knee somewhat swollen, synovial membrane thickened, and much creaking and pain on movement, which was limited. Had ten doses of vaccine. Pain disappeared, the joint became normal in size, the thickening of the synovial membrane became much less and the limitation of movement ceased. No recurrence up to the present time, and this patient recently won a golf championship.

Case 345. Female. (May, 1920). Age 53.—History of rheumatic fever 12 years ago. Twinges of rheumatism all life. In June, 1915, developed pain, stiffness and swelling in the right knee and had to walk with a stick. Had marked pyorrhœa. Returned to England and was treated at Buxton. All her teeth were removed and the rheumatism improved. On the return voyage, the weather was very bad and the left knee became affected. Then the disease spread to the right hand, both ankles, and then to other joints. She gradually became more crippled. In June, 1920, could only shuffle about with a stick. Back was bowed, and stoop on walking stick was marked. Knees very swollen owing chiefly to bony and synovial thickening. Fluid in them was not great. The right ankle was swollen from the same causes. Both hands were swollen. The right hand was crippled, the fingers being flexed and ankylosed, with marked ulnar flexion. The left hand showed slight ulnar flexion. Ordinary rheumatic treatment with salicylates, iodide and radiant heat had no effect. Vaccine administration began in July, 1920. Improvement has continued steadily ever since. There is no pain, and patient can walk two miles with ease, and does not now use a stick. She takes full school duties. Her back is straight and there is no stoop when walking. There is some slight swelling in the knees, and the movement is only three-quarters of normal, though there is full extension. The swelling is due to bony enlargement. The right hand is still deformed, but the use of it has been largely regained. Only bony deformity remains, and the ulnar flexion has become less marked. The left hand still shows bony enlargement of the metacarpo-phalangeal joints of the index and middle fingers. The patient's general health is greatly improved, although she still lives under the same conditions and in the same bungalow as when the disease began.

Case No. 356. Male. (June, 1920). Three years' history.—Complained of pain in the hip joint which caused his legs at times to give way suddenly under him. Pain in other joints on the approach of rainy weather. No limitation of movement observable. Diagnosed as rheumatoid arthritis by specialist in England after X-ray examination. Some swelling observable in the ankle joints, but no limitation of movement. First course of vaccine had done no appreciable good at the conclusion of the injections, but the patient returned shortly afterwards to report that he was distinctly better. At his own request he had a second course then, and has recently had a third. He states that when on leave in England after the second course his doctor said that he had never expected to see him again. At the present moment the pain has entirely left the hip joints and his legs never give way now. His ankles have become normal though he gets slight pain in them when rain is approaching.

Case 373. Male. (July, 1920).—Six years' history of recurrent attacks of rheumatism particularly affecting the legs and knees. Was admitted to a nursing home. Then had slight pyrexia at night, severe pain in both legs, and swelling of the knees, both of which contained fluid. Had eight doses of vaccine. Completely free from symptoms for 18 months although has been elephant shooting. Had a slight recurrence of pain after sleeping out in the rain one night during a hunting trip, and came in at once for more vaccine. Further treatment has cured the relapse.

Case S. Female. (November, 1920).—Had three years' history of increasing pain in small joints of the hands and feet. The hands were almost crippled, and could not be closed. The phalangeal joints of both hands showed spindle-shaped swelling with thickening of the peri-articular fibrous tissue and marked limitation of movement. There was ulnar flexion of the hands. Had ten doses of vaccine. There was entire absence of pain for fifteen months, but there has been slight recurrence of this symptom during the last month and the patient is having a second course of vaccine for this. Although the deformity of the joints has not quite disappeared, it is much less and the limitation of movement has gone, so that the patient is able to carry out her ordinary occupation of farming.

Case W. Male. (November, 1920).—Has had pain and swelling in both knees for three or four months following a soaking in the rain. The knee showed a considerable amount of fluid, but no other pathological changes. Eight doses of vaccine caused a complete cure.

Case 453. Male. (November, 1920).—Acute onset with marked pyrexia. All the joints of the body were affected with acute pain. There was great pain on passive movement of the affected joints, with marked tenderness and some swelling. Had ten doses of vaccine. The pain was very much lessened, but the joint changes were not much improved. Went to South Africa, so had no further vaccine treatment. Was still badly crippled in December, 1921.

Case 460. Male. (November, 1920).—Three years' history. Articular rheumatism on change of weather but no bony changes in the joint. Had eight doses of vaccine and has been entirely free from symptoms ever since.

Case 471. Male. (December, 1920).—Symptoms complained of were pain in the right hip joint so that walking more than a mile caused the leg to give way under him. Diagnosed as osteo-arthritis at home from X-ray examination. Large element of neurasthenia present. No definite improvement after the vaccine.

Case 490. Female. (January, 1921).—No history and no notes available. Patient came to the Laboratory just before returning to England for a supply of vaccine to take with her for fear the symptoms might return while away. She reported that the first series of injections had completely cured her.

Case 553. Male. (July, 1921).—History of occipital headache, pain in the cervical spine, and slight evening temperature for four months. Also had muscular rheumatism. Some slight stiffness of the neck and limitation of movement, otherwise no other clinical signs discoverable in the regions affected. Had eight doses of vaccine. Marked improvement followed and a further series of injections resulted in complete cure.

Case 569. Female. (August, 1921).—Eight years' history of rheumatism affecting all the joints of the body. When attack occurred patient became a complete cripple and was unable to move the joints affected. Markedly worse when the rainy weather began. Small joints of the hands affected for three months. Clinically during the attack there was swelling of the affected joint and fixation by contraction of the muscles moving the joint. Some of the phalangeal joints of the fingers were spindle-shaped with some thickening of the peri-articular tissues. Had eight doses of vaccine. Has since been completely free from symptoms until the rains began a few weeks ago, when there was a slight recurrence of pain in one arm. Further injections of vaccine resulted in cure.

Case 577. Male. (August, 1921).—Had four years' history of rheumatism, the attacks lasting three or four months at a time. Was admitted to hospital 29.8.21, having been ill for five weeks with intense pain in the left hip and along the left sciatic nerve with much wasting of the leg. There was a pyrexia to 100° F. at night. Had six doses of vaccine. Since his discharge from hospital has been on safari and has had no recurrence of the pain.

Case 580. Male. (September, 1921).—Symptoms identical with those of case 553. Had ten doses of vaccine. Has been completely free from symptoms ever since.

CASE 586. Male. (October, 1921).—Age 75.—30 years' history of rheumatism. Been all over the world in search of a cure with no result. Arthritis of both knee-joints, and the small joints of the hands and feet. Marked bony changes in the joints, causing great deformity of the hands with ulnar flexion, and almost complete inability to grasp anything with them. The same change, though less marked, had taken place in the knees and feet, so that the patient was very lame and practically unable to walk. Had 12 doses of the vaccine. No improvement took place beyond a slight diminution of the rheumatic fibrous nodules over the metacarpo-phalangeal joints of the hands, and some lessening of the pain.

CASE 615. Male. (November, 1921).—History of rheumatism. Three weeks before treatment had acute pain in one ankle which incapacitated him for games. Tenderness but no clinical changes in joint. Salicylates gave no relief. Ten doses of vaccine brought about complete cure. Patient now enjoys active life and plays football regularly.

CASE 644. Female. (December, 1921).—Long history of rheumatism in the hands and legs. Recently suffered from occipital headache with marked tenderness along the cervical spine. There was also pain and peri-articular fibrous thickening round the articulations of the fingers. Ten doses of vaccine effected a complete cure.

Eleven other cases are at present under treatment, but it is too early to judge of results. Cases 315, 324, 362, 394, 397, 428, 475, 494, 503, 535 and 610 I have been unable to trace and can obtain no notes on their original condition or of the effects of the vaccine.

Of the cases completed and recorded, I think it may be claimed that Nos. 373, W., 460, 490, 553, 569, 577, 580, 615 and 644 are complete cures, and that Nos. 237, 321, 345, 356, and S., although the condition has not returned to normal, are as much improved as the permanent deformity due to the disease will allow. Case 453 can only be considered as very slightly improved, while cases 471 and 586 must be reckoned complete failures, understandable perhaps in case 586.

From these results it would seem that this method of treatment is worthy of trial in a more extended series of cases than we have at our disposal here. One factor that would have to be taken into account in other countries is that the development of agglutinins as a response to bacillary infection is much less in this part of the world than in England, as has been frequently remarked in reports of Widal reactions here, and also in the experimental inoculation of animals. It may be, therefore, that agglutination with a greater dilution of serum than 1 in 30 for the microscopical method, and 1 in 50 for Dreyer's method will be required as a standard elsewhere to eliminate natural agglutinins in the blood.

Dr. Gilks, Principal Medical Officer, supplied the clinical details of cases 237 and 345, and Dr. Welch, Resident Surgical Officer, European Hospital, Nairobi, the notes of cases 373, S., W., 453, 460, 471, 553, 569, 577, 615, and 644.

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2. Dudgeon, Wordley & Bawtree, *Journal of Hygiene*, Vol. 20, p. 158.
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4. Dudgeon, Wordley & Bawtree, *Journal of Hygiene*, Vol. 20, p. 149.

APPENDIX V.

WATER EXAMINATIONS.

Serial No	Source.	Colonies on Gelatine per c.c. 3 days.	Colonies on Agar per c.c. 2 days.	Colonies on L.B.A. per c.c. 2 days.	B. Coli per litre.	Streptococci per litre.	Bacillus enteritidis sporogenes per litre.
45	Soda water	0	?	0	< 20	< 20	< 20
46	Soda water	60	?	0	< 20	< 20	< 22
47	Soda water	50	6	4	< 20	< 20	< 20
48	Soda water	1	?	1	< 20	< 20	< 20
49	Soda water	0	?	0	< 20	< 20	< 20
50	Kabuggai spring ...	∞	?	∞	100–1000	< 20	> 100
51	Soda water	0	0	0	< 20	< 20	< 20
52	Ginger ale	∞	?	∞	100–1000	< 20	< 20
53	Soda water	0	?	20	< 20	< 20	< 20
54	Soda water	0	6	0	100–1000	< 20	< 20
55	Soda water	0	?	0	< 20	< 20	< 20
56	Soda water	0	?	0	< 20	< 20	< 20
57	Soda water	0	?	0	< 20	1000–10000	< 20
58	Nairobi main	?	55	0	100–1000	< 20	> 100
59	Soda water	0	1	0	< 20	< 20	< 20
60	Nairobi main	?	55	0	20–100	< 20	20–100
61	Soda water	—	?	0	< 20	< 20	< 20
62	Soda water	—	16	0	< 20	< 20	< 20
63	Nairobi main	840	312	21	20–100	< 20	> 100
64	Nairobi main	?	?	22	20–100	20–100	20–100
65	Soda water	34	∞	1	< 100	< 20	> 100
66	Soda water	80	16	0	< 20	100–1000	< 20
67	Soda water	0	?	4	< 20	< 20	< 20
68	Soda water	30	?	13	< 100	< 20	< 20
69	Supply Tank, Nairobi ...	2026	463	15	100–1000	20–100	20–100
70	Nairobi main	50	175	21	100–1000	20–100	< 20
71	Nairobi main	24	499	22	< 100	< 20	< 20
72	Soda water	24	?	0	100–1000	< 20	20–100
73	Nairobi main	?	67	9	100–1000	100–1000	> 100
74	Soda water	0	280	0	< 20	< 20	< 20
75	Soda water	—	?	48	< 20	< 20	< 20
76	Zanzibar spring	—	—	∞	< 20	< 20	> 100
77	Zanzibar spring	—	—	∞	< 20	< 20	< 20
78	Zanzibar main	—	—	∞	100–1000	< 20	< 20
79	Zanzibar tank	—	—	∞	1000–10000	< 20	< 20
80	Zanzibar well	—	—	∞	20–100	< 20	20–100
81	Nairobi main	—	—	7	100–1000	< 20	< 20
82	Soda water	318	—	70	< 20	< 20	< 20
83	Soda water	13	—	15	100–1000	< 20	< 20
84	Nairobi main	?	—	11	1000–10000	< 20	< 20
85	Soda water	36	?	80	1000–10000	< 20	< 20
86	Nairobi reservoir ...	83	877	91	1000–10000	< 20	> 100
87	Supply Tank, Nairobi ...	40	527	57	1000–10000	1000–10000	> 100
88	Nairobi main	?	?	166	100–1000	< 20	20–100
89	Parklands main	∞	∞	∞	100–1000	20–100	< 20
90	Soda water	—	7	2	100–1000	< 20	< 20
91	Nairobi Spring No. 1 ...	22	18	5	< 20	< 20	< 20
92	Nairobi Spring No. 2 ...	4	11	0	20–100	< 20	< 20
93	Nairobi Spring No. 3 ...	15	?	0	< 20	< 20	< 20
94	Nairobi Spring No. 4 ...	408	35	0	< 20	< 20	< 20
95	Nairobi Spring No. 5 ...	?	3500	132	< 20	< 20	< 20
96	Nairobi main	31	401	17	100–1000	100–1000	< 20
97	Nairobi Spring No. 6 ...	91	28	0	< 20	20–100	< 20
98	Nairobi Spring No. 7 ...	139	110	3	< 20	20–100	< 20
99	Nairobi new spring ...	10	40	0	20–100	1000–10000	< 20
100	Soda water	0	?	0	< 20	< 20	< 20
101	Nairobi lower reservoir	∞	∞	156	< 20	< 20	< 20
102	Nairobi upper reservoir	71	1144	130	20–100	1000–10000	< 20
103	Supply Tank Nairobi ...	?	?	0	20–100	< 20	< 20
104	Nairobi main	27	48	18	< 20	20–100	< 20
105	Parklands main	?	∞	5	< 20	< 20	< 20
106	Mission spring, Kikuyu	27	49	38	20–100	1000–10000	< 20
107	Catchment drain, Nairobi reservoir	17	121	15	100–1000	> 10000	> 100
108	Soda water	?	103	0	< 20	< 20	< 20
109	Soda water	?	?	42	< 20	< 20	< 20

Appendix V.—*continued.*

Serial No.	Source.	Colonies on Gelatine per c c. 3 days.	Colonies on Agar per c.c. 2 days.	Colonies on L.B.A. per c.c 2 days.	B. Coli per litre.	Streptococci per litre.	Bacillus enteritidis sporogens per litre.
110	Soda water	?	31	0	< 20	< 20	> 100
111	Soda water	?	?	0	< 20	< 20	< 20
112	Nairobi main	—	112	46	20–100	< 20	< 20
113	Nairobi main	—	278	45	100–1000	< 20	< 20
114	Soda water	—	∞	816	< 100	< 20	< 20
115	Soda water	—	1152	7	< 20	< 20	< 20
116	Nairobi main	18	791	53	< 20	< 20	< 20
117	Soda water	0	18	1	< 20	< 20	< 20
118	Soda water	16	1022	66	< 20	20–100	< 20
119	Nairobi main	27	85	25	1000–10000	< 20	< 20
120	Soda water	2	1772	37	20–100	< 20	< 20
121	Nairobi main	40	243	43	1000–10000	< 20	< 20
122	Nairobi main	12	4112	43	100–1000	20–100	< 20
123	Nairobi main	7	124	24	100–1000	< 20	< 20
124	Nairobi main	20	∞	29	100–1000	< 20	< 20
125	Nairobi main	14	179	54	20–100	100–1000	< 20
126	Soda water	0	145	6	< 20	< 20	< 20
127	Nairobi main	38	265	75	20–100	100–1000	< 20
128	Nairobi main	16	117	242	< 20	20–100	< 20
129	Nairobi main	15	96	54	1000–10000	20–100	< 20
130	Soda water	4	41	5	< 20	< 20	< 20
131	Nairobi Main	?	123	62	1000–10000	20–100	< 20
132	Nairobi Main	162	766	153	1000–10000	20–100	< 20
133	Nairobi Main	—	526	241	> 10000	< 20	20–100
134	Nairobi Main	151	629	140	1000–10000	< 20	< 20
135	Nairobi Main	?	506	209	100–1000	< 20	20–100
136	Kibwezi River	∞	∞	∞	1000–10000	1000–10000	> 100
137	Masongaleni	0	?	12	100–1000	100–1000	> 100
138	Masongaleni	—	—	—	100–1000	100–1000	> 100
139	Masongaleni	—	—	—	1000–10000	100–1000	> 100
140	Nairobi Main	60	380	135	20–100	< 20	20–100
141	Nairobi Main	123	297	72	20–100	< 20	> 100
142	Nairobi Main	45	274	40	20–100	< 20	> 100
143	Nairobi Main	?	640	103	20–100	100–1000	> 100
144	Nairobi Main	?	∞	69	20–100	100–1000	> 100
145	Nairobi Main	83	782	75	20–100	< 20	> 100
146	Nairobi Main	74	348	39	100–1000	20–100	> 100
147	Nairobi Main	101	670	85	1000–10000	20–100	> 100
148	Mombasa Main	∞	∞	∞	20–100	< 20	> 100
149	Mombasa Well	∞	∞	∞	100–1000	< 20	> 100
150	Nairobi Main	?	979	378	1000–10000	< 20	> 100
151	Nairobi Main	?	909	138	1000–10000	< 20	> 100
152	Nairobi Main	36	14	30	100–1000	< 20	> 100

NOTES.

1. Samples 45–126 were examined in 1920 but are included here as a synopsis of them did not accompany the 1920 report.

2. The following samples were taken on the days indicated and are therefore comparable amongst themselves:—

Samples 69, 70 ... ... 7th June, 1920.
Samples 76, 77, 78, 79, 80 ... ... 28th June, 1920
Samples 86, 87, 88, 89 ... ... 9th August, 1920.
Samples 91, 92, 93, 94, 95 ... ... 23rd August, 1920.
Samples 97, 98, 99 ... ... 2nd September, 1920.
Samples 101, 102, 103, 104, 105 ... ... 13th September, 1920.
Samples 106, 107 ... ... 24th September, 1920.
Samples 136, 137, 138, 139 ... ... 14th August, 1921.
Samples 148, 149 ... ... 3rd November, 1921.

3. Samples 76-80 were taken at Zanzibar and packed in a water sample box with ice and dispatched to the Laboratory. As the ice was not renewed and the box took four days to arrive in Nairobi, the greater part of which time was spent in places with a high atmospheric temperature, the examination cannot be considered as of much value in estimating the safety or otherwise of the Zanzibar water supply.

4. In the cases where a high L.B.A. count occurred in association with a low B. coli count, the majority of the colonies on the former medium were non-lactose fermenters.

5. B. coli is only diagnosed when a gram-negative coliform bacillus gives acid and gas in lactose broth, acid and clot in milk, and indol in peptone water.

6. The two waters from Mombasa (samples 148, 149) were four days old when received and the ice in the water sample box was not renewed during the journey. The results of the examination cannot therefore be taken as representing the true condition of the Mombasa water supply.

APPENDIX VI.

DETAILS OF DIFFERENTIAL LEUCOCYTE COUNTS, 1921.

No.	Race.	Age.	Examination for.	Polymorphonuclear Leucocytes.	Large Mononuclear Leucocytes.	Lymphocytes.	Transitional Leucocytes.	Eosinophil Leucocytes.	Myelocytes.	Remarks.
1	N	A	Pyrexia	68	10	13	1	8	—	No parasites
2	E	A	Pyrexia	56	14	20	1	9	—	No parasites
3	E	A	Diff. Count	67	8	18	1	6	—	—
4	E	A	?	78	8	12	—	2	—	—
5	E	A	Pyrexia	3	49	40	8	—	—	No parasites
6	E	A	Pyrexia	47	17	25	6	5	—	No parasites
7	E	A	?	69	9	18	4	—	—	—
8	E	A	Pyrexia	86	8	5	1	—	—	No parasites
9	N	A	Pyrexia	65	5	26	—	4	—	No parasites
10	E	A	Pyrexia	69	19	11	—	1	—	No parasites
11	E	A	?	64	10	20	2	4	—	No parasites
12	E	A	Pyrexia	52	19	28	1	—	—	Polychromes
13	E	A	Pyrexia	83	6	10	1	—	—	No parasites
14	E	A	Pyrexia	63	14	22	—	1	—	No parasites
15	E	A	Pyrexia	20	61	18	1	—	—	No parasites
16	E	A	Pyrexia	72	10	16	1	1	—	No parasites
17	E	C	Pyrexia	56	14	27	3	—	—	No parasites
18	E	A	Diff. Count	30	9	56	4	1	—	No parasites
19	E	A	Pyrexia	59	31	8	2	—	—	No parasites
20	E	A	Pyrexia	42	29	26	3	—	—	Polychromes
21	E	A	Pyrexia	76	18	8	—	—	—	No parasites
22	E	A	Diff. Count	82	10	7	1	—	—	No parasites
23	I	A	Diff. Count	74	10	15	—	1	—	No parasites
24	I	A	Pyrexia	46	12	40	—	2	—	No parasites
25	E	A	Pyrexia	59	13	26	1	1	—	No parasites
26	E	A	Pyrexia	73	8	17	1	1	—	No parasites
27	E	A	Pyrexia	78	8	13	—	1	—	No parasites
28	E	A	Pyrexia	51	12	33	2	2	—	No parasites
29	E	A	Pyrexia	81	3	13	—	3	—	No parasites
30	E	A	?	61	11	25	1	2	—	No parasites
31	E	A	Pyrexia	58	10	27	1	4	—	No parasites
32	E	A	Pyrexia	58	12	22	2	6	—	No parasites
33	E	A	Pyrexia	52	12	31	1	4	—	No parasites
34	E	C	Pyrexia	44	16	36	3	1	—	No parasites
35	N	A	Pyrexia	67	3	23	—	4	3	No parasites
36	E	A	Pyrexia	54	8	32	5	1	—	No parasites
37	E	A	Pyrexia	41	16	39	4	—	—	No parasites
38	E	A	Pyrexia	32	26	36	2	4	—	No parasites
39	E	A	Diff. Count	22	19	56	3	—	—	No parasites
40	E	A	Pyrexia	56	16	20	8	—	—	No parasites
41	E	A	Diff. Count	80	3	17	—	—	—	No parasites
42	?	?	Diff. Count	32	25	11	2	30	—	No parasites
43	E	A	Pyrexia	85	5	6	4	—	—	No parasites
44	E	A	Diff. Count	57	9	27	2	5	—	No parasites
45	I	A	Diff. Count	22	4	73	1	—	—	No parasites
46	E	C	Pyrexia	30	15	14	—	41	—	—
47	E	A	Pyrexia	26	60	9	5	—	—	No parasites
48	E	A	?	65	9	22	4	—	—	No parasites
49	E	A	Pyrexia	93	5	1	—	1	—	Mastoid abscess
50	E	A	Pyrexia	72	14	13	1	—	—	No parasites
51	E	A	Pyrexia	37	43	12	7	1	—	Crescents present
52	N	A	Diff. Count	56	12	24	4	4	—	No parasites
53	E	A	Diff. Count	42	34	18	6	—	—	No parasites
54	?	?	Diff. Count	18	4	56	10	—	12	Poililocytosis
55	I	A	Diff. Count	70	5	25	—	—	—	No parasites
56	E	A	Pyrexia	48	20	12	20	—	—	No parasites

Appendix VI.—*continued.*

No.	Race.	Age.	Examination for.	Polymorphonuclear Leucocytes.	Large Mononuclear Leucocytes.	Lymphocytes.	Transitional Leucocytes.	Eosinophil Leucocytes.	Myelocytes.	Remarks.
57	E	A	Pyrexia	32	8	28	32	—	—	No parasites
58	E	A	Pyrexia	3	16	30	50	—	1	No parasites
59	E	A	Pyrexia	73	12	12	2	1	—	No parasites
60	E	A	Pyrexia	72	7	17	1	3	—	No parasites
61	E	A	Diff. Count	3	30	6	60	—	1	No parasites
62	I	A	Diff. Count	48	5	30	16	1	—	No parasites
63	E	A	Pyrexia	34	8	38	—	20	—	No parasites
64	E	A	Diff. Count	35	20	31	14	—	—	No parasites
65	E	A	Pyrexia	40	27	33	—	—	—	No parasites
66	N	A	Pyrexia	54	28	11	1	6	—	No parasites
67	E	A	Pyrexia	76	4	20	—	—	—	No parasites
68	E	A	Pyrexia	34	19	5	41	8	3	No parasites
69	E	A	Pyrexia	75	11	9	5	—	—	No parasites
70	E	A	Pyrexia	80	8	11	—	1	—	Polychromes
71	I	A	Pyrexia	78	8	14	—	—	—	Polychromes
72	E	A	Pyrexia	81	8	10	1	—	—	No parasites
73	E	A	Pyrexia	64	7	28	—	1	—	No parasites
74	?	?	Pyrexia	67	24	7	2	—	—	Polychromes
75	I	C	Pyrexia	72	8	20	—	—	—	No parasites
76	E	A	Pyrexia	79	3	17	1	—	—	No parasites
77	I	A	Pyrexia	65	5	17	3	10	—	Polychromes
78	E	A	Pyrexia	68	14	17	—	1	—	No parasites
79	I	A	Pyrexia	71	8	16	2	3	—	No parasites
80	E	A	Pyrexia	78	12	10	—	—	—	No parasites
81	E	A	Pyrexia	60	15	23	2	—	—	No parasites
82	N	A	Pyrexia	43	39	13	3	2	—	No parasites
83	E	A	Pyrexia	57	19	12	2	10	—	No parasites
84	E	C	Pyrexia	51	12	25	2	10	—	Bilharziasis
85	?	?	Diff. Count	56	13	28	1	2	—	No parasites
86	N	A	Pyrexia	68	4	27	—	1	—	No parasites
87	E	A	Pyrexia	74	13	13	—	—	—	No parasites
88	E	A	Pyrexia	89	2	8	1	—	—	No parasites
89	E	A	Pyrexia	66	11	21	2	—	—	No parasites
90	E	A	Pyrexia	80	8	10	1	1	—	No parasites
91	E	A	Pyrexia	61	11	25	1	2	—	No parasites
92	E	A	Pyrexia	81	6	12	1	—	—	Polychromes
93	E	A	Diff. Count	71	2	26	1	—	—	No parasites
94	I	A	Diff. Count	79	7	13	—	1	—	No parasites
95	N	A	Diff. Count	58	23	18	—	1	—	No parasites
96	E	A	Trypanosomes	43	8	47	—	2	—	No parasites
97	E	A	Diff. Count	65	26	9	—	—	—	No parasites
98	I	A	Pyrexia	70	10	18	—	2	—	No parasites
99	N	A	Diff. Count	76	9	13	—	1	1	No parasites
100	I	A	Pyrexia	42	21	32	2	3	—	Polychromes
101	E	A	Diff. Count	83	5	10	2	—	—	No parasites

A = Adult. C = Child. Diff. Count = Differential Leucocyte Count. E = European.
I = Indian. N = Native.

APPENDIX VII.

DETAILS OF CASES OF YAWS INVESTIGATED AT KISII.

Case No.	Age.	Sex.	Duration in Weeks.	Site of primary yaw.	Period between primary desion and secondary eruption.	S. pertenue (present + absent —).	Wassermann reaction.	Differential leucocyte						Diagnosis.
								Polymorphonuclear.	Large Mononuclears.	Lymphocytes.	Transitionals.	Eosinophiles.	Mast cells.	
1	4	M	?	Thigh ...	?	+	?	44	20	36	—	—	—	Secondary yaws
2	A	M	12	Leg	4	+	++	51	2	37	—	10	—	Secondary yaws
3	A	M	16	Knee	8	+	++	53	13	25	—	9	—	Secondary yaws
4	A	M	24	Thigh ...	20	+	+	46	8	36	—	10	—	Secondary yaws
5	14	F	8	Occiput ...	3	+	++	29	48	16	—	7	—	Secondary yaws
6	11	F	12	Scalp ...	4	+	++	53	7	36	—	4	—	Secondary yaws
7	A	M	20	Penis ...	16	+	++	50	20	23	1	6	—	Secondary yaws
8	13	M	16	Upper lip ...	?	+	++	56	17	21	5	—	1	Secondary yaws
9	A	F	16	Elbow ...	8	+	++	76	12	7	3	2	—	Secondary yaws
10	11	M	12	Knee	8	+	++	82	7	9	1	1	—	Secondary yaws
11	6	M	?4	Angle of mouth	6	+	++	68	6	24	2	—	—	Secondary yaws
12	9	F	60	?	?	—	++	66	6	25	3	—	—	Tertiary yaws
13	A	M	8	Buttock ...	4	+	++	56	30	10	4	—	—	Secondary yaws
14	A	M	12	Groin ...	3	+	++	57	17	21	—	5	—	Secondary yaws
15	16	F	8	Breast ...	4	+	+±	31	49	15	2	3	—	Secondary yaws
16	16	F	8	Groin ...	4	+	++	36	13	49	—	2	—	Secondary yaws
17	5	M	12	Leg	8	+	++	55	28	16	—	1	—	Secondary yaws
18	8	F	8	Forehead ...	?1/3	—	+±	58	14	24	—	4	—	Secondary yaws
19	8	M	4	Axilla ...	1/3	+	++	66	5	19	—	10	—	Secondary yaws
20	A	F	M'ths.	?	—	—	++	60	9	30	—	1	—	Tertiary yaws
21	A	F	12	Nipple ...	8	—	++	61	12	19	—	6	2	Secondary yaws
22	A	M	12	—	?	—	0	31	39	30	—	—	—	Doubtful. Not yaws
23	A	F	Years	?	?	—	++	71	21	8	—	—	—	Tertiary yaws
24	7	F	8	Angle of mouth	4	+	++	40	22	33	—	2	3	Secondary yaws
25	A	F	12	Thigh ...	?	+	++	—	—	—	—	—	—	Secondary yaws
26	A	M	12	Penis ...	8	+	0	51	26	23	—	—	—	Secondary yaws
27	14	F	4	Thigh ...	2	+	++	82	10	5	—	2	1	Secondary yaws
28	8	F	8	Thigh ...	4	+	++	68	6	22	—	4	—	Secondary yaws
29	18	F	—	—	—	—	++	58	21	17	4	—	—	Doubtful. ? Tb.
30	A	M	8	Knee	3	+	++	60	27	13	—	—	—	Secondary yaws
31	A	F	8	Knee	4	+	+±	80	12	8	—	—	—	Secondary yaws
32	8	F	4	Hand ...	½	+	++	42	6	43	1	8	—	Secondary yaws
33	A	F	12	Face	4	+	+±	66	10	24	—	—	—	Secondary yaws
34	A	M	12	Finger ...	10	—	?	45	6	42	2	5	—	Secondary yaws

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